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STANDARDIZATION IN THE ELECTRICAL INDUSTRY.

It has been characteristic of the development of most industries that as they progress standardization of their products becomes more and more marked. This is especially true of industries in which applied science predominates. Taking the electrical industry as a whole, this is certainly very true. In the early days of the industry standardization was unheard of; as the industry has evolved and its lines of development have become more and more clearly marked, the necessity for standardization has become more urgent. An illustration of this is the extent to which the Standardization Rules of the American Institute of Electrical Engineers have grown from the first modest draft, which appeared in 1899. In the last edition of these rules, which was promulgated to take effect on July 1 of this year, these rules required a pamphlet of nearly 100 pages in their published form and comprised nearly 1,000 sections.

The Standardization Rules of the American Institute have been drafted with the chief idea of defining the terms and conditions which characterize rating and behavior of electrical apparatus, with special reference to the conditions of acceptance tests. As stated in the preface to the rules, it has not been the purpose to standardize the dimensions or details of construction of any apparatus, lest the progress of design and production should be hampered. In other words, it may be stated that these rules have for their primary object the setting of definite standards of quality for electrical apparatus.

There is another kind of standardization which becomes more needed as the growth of an industry requires that not only shall the quality of its products be standardized, but that certain dimensions and other characteristics thereof be made uniform so as to permit as free interchange as possible. Probably the best example of this type of standardization is in the very extensive sets of rules laid down in the railway industry. The origin of this is primarily to permit ready interchange of cars from one system to another and such interchange necessarily involves accurate specification of such dimension as gauge of track, height of couplers and uniformity in type of couplers, etc. In the electrical industry much has already been done without any special deliberate and comprehensive action that may be characterized as a code of standardization of this character. For example, the almost universal voltage that has been in use in this

country for a great many years for lighting circuits and other circuits requiring relatively small power is 110 volts or in the neighborhood of 110; lamp sockets are well standardized by adoption of the Edison screw base type; many other examples of such electrical standardization readily come to mind. The hampering of development which would result from any tendency to abandon the two simple standards referred to, for instance, would cause untold difficulties.

The question of further standardization of sizes, voltages, speeds and other characteristics of electrical apparatus is now being taken up by several organizations. Among these is the National Electric Light Association, whose proposed manufacturers' section will prominently consider questions of standardization. One of the committees of this association has during the past year made considerable progress in the effort to secure standardization of plugs and receptacles. The Electric Power Club, an organization of motor manufacturers, has developed some standardization ideas as regards motor speeds and sizes of pulleys. As pointed out in the article by Mr. Harry N. Gilbert, which appears on another page of this issue, there are numerous advantages to such standardization. Among these are that the manufacturer is able to carry stock machinery and stock parts and can, therefore, supply orders much more promptly; the calls for odd speeds and special ratings being diminished, the manufacturer can concentrate his efforts on the more efficient production of standard machines with reduction in the cost of manufacture and lowering of selling price.

The subject of motor standardization was also taken up at last week's convention of the New England Section of the National Electric Light Association, which is reported in this issue. This particular discussion related to the standardization of motor voltages and a number of speakers advocated that motors of 7.5 to 25 horsepower should be 220-volt motors, while those over 25 horsepower should be 550-volt motors; others spoke in favor of adopting 2,200 volts for the very large machines.

The standardization of dimensions, voltages, speeds, shapes, etc., will become more and more important and should be given all encouragement to have it carried out in the most reasonable manner. The national organizations, such as the National Electric Light Association and American Institute of Electrical Engineers, should take up the matter and after a thorough discussion attempt to bring about greater uniformity without restricting possible future beneficial development. It should be kept in mind that the primary object of such standardization should be greater utility of the apparatus through more extensive interchangeability and also through possible reduction in cost. Both of these considerations will make for greater use of electrical apparatus of all kinds and, therefore, be of mutual benefit to all branches of the electrical industry.

DISPOSITION OF REFUSE FROM WOODWORKING PLANTS.

There is a natural tendency on the part of central-station power engineers and salesmen, in soliciting new business, to avoid at least for as long a time as possible, woodworking plants, especially those having large amounts of refuse. Invariably the manager of such an establishment, when approached by the representative of the utility company, points to the fact that wood refuse is available for power generation and in view of this it would be grossly extravagant to purchase central-station power, even granting that the advantages set forth by the salesmen are true.

There are some few cases where progressive woodworking plants have discarded isolated steam-plant equipment in favor of electric power solely on the basis of greater reliability, flexibility and more uniform speed of the driven machines, disregarding entirely the question of refuse and its apparent value as fuel. In the majority of instances, however, the securing of this class of business hinges largely on the cost per unit of power and the question of refuse disposal becomes then of paramount importance.

The actual solution of this problem is entirely a local consideration depending, of course, upon the conditions in each individual case. That the solution rests with the power engineer is equally apparent and if the business is to be secured a careful study of all phases of the problem must be made. There are many localities where a demand exists or where through the ingenuity of the power salesman a demand can be created for sawdust, shavings, kindling, etc., for packing purposes, bedding, butcher shops, bakeries, etc. It is obviously the duty of the central-station man to investigate what outlet can be found for the refuse, ascertain the prices that can be secured and upon these data base the company's proposition.

No single item has contributed more to the failure of central stations to secure the business of the woodworking plants than the tendency of the salesman to accept the statement of the manufacturer that because of the refuse being available his power "costs practically nothing." In one notable instance the power engineer after accepting this answer on several visits obtained permission to make an analysis of actual conditions. He found that because of the rapid accumulation of waste the chief duty of the fireman was to get it out of the way, regardless of fuel requirements and efficiency. This policy worked out satisfactorily in summer but during the cold months when heat was required in the building and the dry kiln made extra demands upon the plant, enough money was expended for coal to practically pay for the cost of central-station power. The conditions were outlined to the manager and a contract subsequently signed. Under the new regime all wood refuse not burned to supply the kilns was saved for use during the heating season. In addition large

quantities of sawdust and shavings were sold and the revenue thus secured applied on the cost of power.

While this may perhaps be an extreme case it serves to illustrate the importance of considering the question of refuse disposal from every angle. Too many manufacturers honestly believe that because waste material is burned power costs nothing and an intelligent analysis will at least correct this impression and aid that much in strengthening the position of the power company.

On other pages of this issue there appears an article by Mr. F. O. Alton, of Columbus, giving his experiences in disposing of refuse from woodworking plants. Many new plans are presented and the paper is worthy of the careful perusal of all those interested in securing this class of business.

THE RUPTURE OF DIELECTRICS BY TRANSIENT VOLTAGES.

That both time and energy are necessary in the production of an electric discharge through an insulating medium has been recognized for many years and has been frequently reiterated by the engineers from Schenectady, who have done so much investigation in high-voltage phenomena. Another contribution to this subject was made by Mr. F. W. Peek, Jr., at the convention of the American Institute. This paper described the effect of the application of transient voltages to insulating materials and furnished definite and quantitative information upon a subject which has heretofore been understood mainly in a qualitative way. The results of these experiments serve to explain a number of phenomena which have been observed in operating experience, but the causes for which have not heretofore been clearly understood. It may be of value to summarize here some of the results obtained and the conclusions deduced therefrom.

The requirement of the expenditure of energy to rupture a dielectric naturally introduces a time element which is of no importance where voltages, direct or alternating, are continuously applied, but which is of great importance in the case of transient voltages. Thus a surge with a steep front may pass entirely by a spark gap before spark-over occurs, even though the same voltage applied continuously would cause a spark; thus apparatus intended to be protected does not receive the desired protection. The more rapidly the voltage is applied, the higher the value which will be attained before a discharge passes. In some cases this instantaneous voltage may be twice as great as the continuously applied voltage which would produce a discharge. The magnitude of this ratio depends upon the amount of energy required. Thus, for a sphere gap it is much less than for needle points. The time lag and the voltage rise for a given gap are not definite quantities, but are dependent upon the rate of application of the voltage. They are greater in case where the field is non-uniform.

The effect of initial ionization in air is generally not great but may be so under certain conditions. For dissimilar electrodes, the spark takes place at the lowest voltage when the electrode in the densest field is positive. For uniform fields the polarity is of no importance. On smooth surfaces of solid dielectrics the time lag is very small but becomes greater where there are corrugations.

In oil and other liquid dielectrics the energy and consequently the time lag and the relative voltage are greater than in air. The lag and relative voltage are highest in solid dielectrics.

The quantitative values obtained by Mr. Peek for the various conditions affecting these phenomena will add greatly to the available information and data pertaining to this subject.

INDUCTIVE INTERFERENCE.

The two sessions at the Panama-Pacific convention of the American Institute of Electrical Engineers which elicited the greatest interest were those dealing with the appraisal of public utilities and with inductive interference between power and telephone lines. These subjects involve economic and financial considerations, and it is notable that the engineer of the present day has as lively an interest in matters of this kind as in the more strictly technical and engineering questions.

The report of the California Committee on Inductive Interference contained not only an outline of work which has been done during the past year and that contemplated for the future, but also carried some encouragement to the representatives of power companies who have felt that the first report of this Committee, and the rules promulgated by the California Railroad Commission as a result thereof, would represent considerable hardship to them if generally adopted in other territories. These rules have appeared to give to the telephone companies the power to say what constituted a parallel, and to put upon the power companies the burden of avoiding such a condition. The members of the Committee assured the meeting that this was not the intention and that the final report of the Committee will make clear, not only what constitutes a parallel line, but other points which have heretofore been involved in considerable uncertainty, and thus clarify the rules which are already nominally in effect. The issuance of this supplementary report will be awaited with considerable interest by the power companies of other states as well as in California, as it is realized that the precedent set by the California Railroad Commission may be followed elsewhere. The work of the Committee on Inductive Interference is indeed of national importance and an attempt is to be made to secure the interest and financial assistance of power companies outside of California in continuing the work of the Committee. The telephone interests involved already represent more than the local operating companies. The Railroad Commission of California has contributed but a part of the expense of this work, and to secure the best results outside assistance will be needed.

Convention of the American Electric Railway Association to be of Exceptional Importance.

The thirty-fourth annual convention of the American Electric Railway Association and its five affiliated associations, which will be held in San Francisco, Cal., October 4 to 8, will be of unusual importance to the industry that it represents. The program includes 22 addresses and papers, 80 reports of committees, and a number of written discussions.

Many men distinguished in public life or by their achievements in the field of electric transportation will speak before the convention. Governor Hiram W. Johnson of California will deliver the address of welcome. Ex-Senator Jonathan Bourne, Jr., of Oregon, will speak on "The Evils of Government Ownership." As a national legislator, Mr. Bourne was the author of the Parcel Post Law; he has long been one of the most efficient workers in the country-wide movement for the construction of good roads, and in other matters of national importance. "Welfare Work" will be the subject of Jesse W. Lilienthal's address; he is president of the United Railroads of San Francisco, a lawyer of eminence and a director in many corporations that have played an important part in the upbuilding of the Pacific Coast. He has become famous throughout America as a philanthropist of high ideals and great practical achievement.

Bion J. Arnold will discuss "The Foundation Principles of the Valuation of Electric Railways." No one is better qualified to speak authoritatively on such a subject, which is one of the most pressing questions of the day. Mr. Arnold has been the chief consultant or executive, or both, in the building or direction of many great transportation lines. He is the chief engineer and chairman of the Board of Supervising Engineers, Chicago Traction, under whose supervision the rehabilitation and extension of the Chicago surface lines has and is taking place; he is also consulting engineer of the Public Service Commission, First District, New York City, on matters connected with subways and street-railway properties; consulting engineer, Detroit United Railway, and also holds a similar position with the cities of Pittsburgh, Providence, Kansas City, Los Angeles and San Francisco. As an inventor whose devices have aided materially in the progress of electric and steam transportation, he is no less famous.

Among the many committee reports, that concerning the operation of motor vehicles and summarizing the investigations regarding the "jitney" situation will be of especial interest. Another report of a committee of the American Association, that on the Cost of Passenger Transportation Service, is also noteworthy, including as it does the results of the exhaustive studies which the Bureau of Fare Research has been making for the last year.

P. V. Burington, secretary, Columbus (O.) Railway, Power & Light Company, will present before the Accountants' Association a paper on "Electric Railway Accounting—A Review," and Prof. Carl C. Plehn, of the University of California, will speak on "The Taxation of Electric Railways."

The Engineering Association's Committees on Power Distribution and Way Matters will present reports of unusual value. The report of the Committee on Heavy Electric Traction, and the joint report of the Engineering and Transportation and Traffic Associations' Committee on Block Signals will be thorough and comprehensive.

In the meetings of the Claims Association the subjects of the principal papers will be: "The Prevention of Motor Vehicle Accidents," by S. B. Hare, Altoona, Pa.; "Standardization of Claims Statistics," by E. E. Slick, Anderson, Ind.; "A Card Index and What It Means," by J. J. Reynolds, Boston, Mass.; "Safety and Its Relation to Conservation," by B. F. Boynton, Portland, Ore.

The Transportation and Traffic Association's Committee on Construction of Schedules and Time Tables, and that on Fares and Transfers, will renuer reports that, in their conclusions, represent distinct advances along the lines concerned. A notable address before this association will be "The Relation of Electric Railways to Agriculture," by Paul Shoup, president, Pacific Electric Railway Company, Los Angeles, Cal.

N. E. L. A. Wiring Committee Meets.

A meeting of the Wiring Committee of the Commercial Section of the National Electric Light Association was held on September 17 at the headquarters in New York City.

On the question of the standardization of plugs and receptacles a report was presented from Mr. Benjamin, representing the manufacturers of the angle-pull type, and Mr. Sargent representing the manufacturers of the straight-pull type, and other information was presented to the committee which will be submitted to the manufacturers of both types before being further published.

On the question of bare concentric wire, several members reported on installations already made in their cities, using standard American fittings, and H. R. Sargent, of the General Electric Company, reported that in accordance with the request of the committee, the General Electric Company was going ahead with the preparation of special fittings and possibly a few special tools and hoped to have these ready by the middle of November.

It is the opinion of the committee that as soon as these fittings are ready, a very large number of additional installations will be made with the permission and for the information of the Underwriters and other inspectors.

On the question of the solid neutral, it was reported that the Sprague Electric Works are getting out a bulletin showing panelboards designed for the use of solid neutrals without fuses or switches on the grounded wires, either the grounded neutral or the grounded side of two-wire circuits, which would result in a very distinct reduction in the cost of large installations as well as being in accordance with the new safety rules.

It was recommended that the various members of the committee take steps in their various cities to have this principle recognized and approved by the local inspectors.

Circular 54 of the Bureau of Standards had been referred to the committee by the National Electric Light Association for report and a number of recommendations in regard to the same were drawn up which will be submitted to the representatives of the National Electric Light Association who are to appear before the Bureau of Standards at a conference on October 27.

It was decided to hold the next meeting of the committee in Schenectady, N. Y., some time in November when the new concentric-wiring fittings of the General Electric Company will be ready.

Railway Signal Association's New Officers.

The Railway Signal Association held a very successful convention at Salt Lake City, Utah, on September 13 to 16. On the concluding day of the meeting the following were elected as officers for the ensuing year: W. J. Eck, Washington, D. C., president; C. A. Dunham, St. Paul, Minn., first vice-president; W. H. Elliott, Albany, N. Y., second vice-president; C. C. Rosenberg, Bethlehem, Pa., secretary-treasurer.

New Display Room for Athens Company.

The Athens Electric Company, of Athens, O., has made arrangements to open a downtown office which will also serve as a display room for various electrical appliances. Bills will be payable at this office, and sales of electrical goods carried on, as well as work in connection with house-wiring, which will be handled by the company on easy terms, in pursuance of its policy.

Electricity in Twine and Rope Mills.

Twine and rope mills offer a particularly attractive field to the central-station company because of their high load-factor and the necessity for close speed regulation. This article comments on the advantages of electric drive and gives data on the installation in a large eastern mill.

Twine and rope mills offer especially attractive business to the central station as the load-factor is high and the demand for current is during the off-peak part of the day. In-so-far as the advantages of electric drive are concerned, this industry may be classed with many others in a great many respects, but there are a few specific advantages which may be mentioned. Group drive is principally employed so that only short lines of shafting and comparatively light belts are required, which reduces speed variations due to belt slippage to a minimum as compared with long lengths of shafting and other mechanical transmission devices. The uniform speed thus secured means an increased production and a more uniform product. In all rope and twine mills there is always prevalent a large quantity of dust and small particles from the raw product distributed over the girders, which are extremely inflammable. Heated journals, frequently occurring with heavy shafting, and static sparks from heavy belts are a constant menace as such conditions are always liable to ignite the waste material and cause a serious conflagration.

Spinning Room of International Harvester Company's Twine Mill.

Any group of machines may be shut down to facilitate repairs without interfering with the operation of any other group, and what is still of greater importance, in case of an accident it is possible to bring a section of shafting to rest in a much quicker time than it would if mechanical power from a central source was used. Although due precaution for the safety of employees is generally present in mills of this class, the "safety first" principles demand a quick means of stopping machinery and auxiliary appliances.

In general the manufacture of twine is the first stage of rope making, the latter process consisting of combining the twine or fibers by twisting them by proper machinery. Obviously any size rope can be made by combining the proper number of strands. The materials used for the manufacture of cordage and rope are hemp and jute. Hemp is a tall annual herb of the nettle family with small green flowers, and a tough bark. A strong and tough fiber is obtained from it which is especially adapted to the manufacture of cordage. The fiber is similar to flax, but coarser and stronger. Sisal-hemp, a species of Agave, produced in large quantities in Yucatan and Key West, is superior to the true hemp and is used for some classes of product. Jute is obtained from two tall annual Asiatic herbs of the linden family from which fiber is

also obtained. In the manufacture of cordage and rope the different qualities of hemp and jute are frequently combined to produce various grades and strengths of the output.

The first operation is carried on in the opening room where the raw material, which is received in bales, is unpacked and shaken out. Next, the material is passed through a series of breakers which consist of an endless traveling belt provided with hackle pins which comb or straighten out the fibers and even them up. The material is fed into one end of the breaker and emerges in what is known as a "sliver" two or three inches in diameter, where it coils itself in a barrell-like container. The material then passes through a second or third breaker and similar machines for further refinement, when it is transferred to the spinner for spinning into cord or yarn. The first part of the spinning machine is similar in construction to a breaker with the addition of mechanism for spinning and reeling onto a bobbin. Some spinners "tube" the yarn, that is, pass it through a tube to render it smoother.

From the spinning room the bobbins are taken to the tar house and placed in frames conveniently arranged with reference to the tar box which is filled with tar or similar preparation. During tarring the liquid is maintained at 220 degrees Fahrenheit by means of steam heaters. The cord or yarn is led from the bobbins in the frame through two or more single guide plates working in a vertical plane over the tar box convenient for lowering into the tar. The cord or yarn is then led to the further end of the tar box and passes between metal rollers which press out and return to the box superfluous liquid. It is then wound onto a drum for cooling and finally wound onto a fresh set of bobbins with great regularity.

If the product is to be used as cordage, the bobbins are transferred to automatic balling machines and the cord or yarn is balled ready for the packing room and shipment. If the product is to be made into rope the bobbins are placed in the rope machines which first prepare the strands, generally consisting of three yarns. In the rope machine proper the strands pass through a circular revolving plate and other mechanism which gives the strands the proper twist to form the rope.

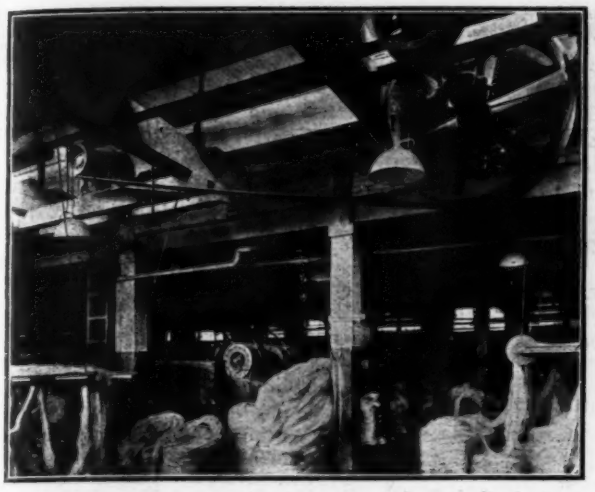
The following description relates to the twine and rope mills of the International Harvester Company at Auburn, N. Y. These mills have a capacity of 51 tons of binder twine daily, with a rope department which turns out enough small rope for baling the finished product. At the present time approximately one-third of the entire

Finishers and Sett Machines Driven by 35-Horsepower Motor.

mills are electrified, the motor drive being distributed through all departments. From this it will be evident that electric power takes care of about 17 tons of finished product daily. There are 25 electric motors in operation, all of which are General Electric three-phase, 25-cycle, 440-volt machines with the exception of one direct-current motor which operates a bale hoist in the warehouse. Some half mile distant from the mills the company maintains a pumping station that furnishes condensing water for the steam equipment. These motors are not included in the schedule as they do not enter directly into the manufacturing process. The aggregate horsepower of the motor installation is 720, the individual motors varying in ratings from 10 horsepower to 75 horsepower.

All of the product of the twine mills is used by the International Company in connection with its harvesting machinery. The various departments of the twine mills include opening rooms, preparing rooms, spinning rooms, balling rooms, shipping department, and rope department. In the preparing room where the preparation of the raw material for spinning is carried on, the equipment includes breakers, spreaders,

Fifty-Horsepower Driving 52 Spinning Frames in Twine Mill.



American Finisher Driven by 35-Horsepower Motor.

Three Twine Machines Driven by 25-Horsepower Motor.

indicators, Sett machines and finishers. All of these machines are used in the preliminary manufacturing process and the raw material is further refined as each succeeding machine is passed. There are two preparing rooms, one for what is known as the Irish process and the second for the American process. Both processes are similar in principle as well as the machinery but vary in the combination of the raw materials.

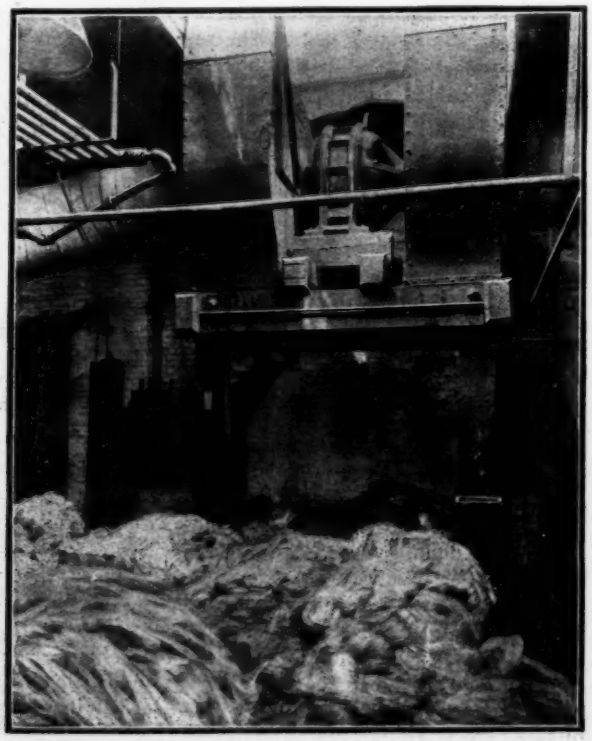
Manual operation only is employed in the opening room, but to remove the dust there are two 50-inch exhaust fans driven by a 50-horsepower motor placed between the two and direct coupled to the fans. The fans and the driving motor are mounted on a platform supported by the ceiling girders. In all departments the motors are mounted on I-beams supported by the roof girders and are placed in such a location that a reasonably short belt only is required to drive the jack shaft which is in turn belted to the driving shafts of the group of machines.

It must be understood that these mills were formerly entirely driven from a central steam plant and that the location of the various machines corresponds to that idea. With the installation of electric power the machines have been divided into groups for the various motors with a view to compactness and not of logical sequence of operations. At the present time similar machines may be driven by both mechanical and electric power. It is the intention to electrify the entire plant, but of course this is a matter of transition.

In the electrification of the mills the motor speeds and the pulley diameters have been proportioned to give the same machine speeds as with mechanical drive.

In the Irish preparing room the motor-driven machines consist of two first breakers, three second breakers, three third breakers, four spreaders, one roving frame, four indicators, three Sett machines and three finishers. The breakers were briefly described at the beginning of this article but are, of course, somewhat more complicated and have many refinements and minor

Two 75-Horsepower Motors, Each Driving 62 Spinning Flyers.



Two 50-Inch Exhaust Fans Direct-Coupled to 50-Horsepower Motor.

details. The spreader is based upon the same principle as the breaker as well as the indicators, Sett machines and finishers.

Indicators, or bell machines as they are sometimes called, derive their name from the fact that they indicate by the ringing of a bell when a predetermined amount of raw material has passed through the machine which is generally set at 370 pounds. Any variation in the weight indicates that the wrong proportion of materials is being fed through the various machines. Material from two indicators is combined in the Sett machine. In this way two varieties of the raw material can be combined.

In the Irish preparing room the machines with the driving motors are grouped as follows: two first breakers and one freight elevator driven by a 20-horsepower motor; two second breakers, one spreader, one third breaker and one roving frame, driven by a 25-horsepower motor; one second breaker and one spreader driven by a 10-horsepower motor; four indicators and three spreaders driven by a 35-horsepower motor; three Sett machines driven by a 20-horsepower motor; three finishers driven by a 25-horsepower motor.

In the American preparing room the equipment of machines is smaller and consists of one first breaker; one second breaker; two spreaders; one indicator; three Sett machines and nine finishers. This enumeration of machines refers, of course to the motor-driven apparatus. The grouping is quite similar to that of the Irish preparing room as will be seen by reference to the motor data table. The removal of dust in the Irish finishing room is provided for by two 36-inch exhaust fans driven by a 20-horsepower having the same mechanical arrangement as the fans and motor in the opening room. In the American preparing room the exhaust fan outfit consists of a 40-inch and a 60-inch fan driven by a 35-horsepower motor.

There are two spinning rooms, one with an equipment of 52 spinning flyers driven by a 50-horsepower motor, and two groups of 62 spinning flyers each driven by a 75-horsepower motor. In the second spinning room there are two groups of 46 flyers each driven by a 50-horsepower motor. Electric drive is used exclusively in the spinning rooms. The balling room has an equipment of 32 balling flyers driven by a 35-horsepower motor. The rope department as stated before is maintained for furnishing packing rope for the twine mills product and is therefore small in comparison to the mills proper, the group of machines consisting of two card machines, one draw frame, three formers, two rope layers and one picker. This group is driven by a 25-horsepower motor.

Conduit work is used throughout the mills and all auto-starters are mounted on building pillars in close proximity to the motors they control. Empire Gas & Electric Company's service is used, the transformers and main switchboard being located at the No. 2 mills of the International Company about one-half mile distant.

MOTOR DATA.

International Harvester Company's Twine Mills, Auburn, New York. Three-phase, 25-Cycle, 440-Volt System.

No.	Horsepower.	Application.
1	20	Two first breakers, one freight elevator.
1	25	Two second breakers, one spreader, one third breaker, one roving frame.
1	10	On second breaker, one spreader.
1	35	Four C. B. & C. indicator machines, three spreaders.
1	20	Three C. B. & C. Sett machines.
1	25	Three C. B. & C. finishers.
1	15	One first breaker and one spreader.
1	35	One second breaker, one third breaker, one spreader, two indicators.
1	35	Three Sett machines, nine finishers.
1	20	Fifty-two spinning flyers.
1	75	Sixty-two spinning flyers.
1	75	Sixty-two spinning flyers.
1	50	Forty-six spinning flyers.
1	50	Forty-six spinning flyers.
1	35	Thirty-two balling flyers.
1	25	Two card machines, one draw-frame, three formers, two rope layers, one picker.
1	50	Two 50-inch fans for dust exhaust. Opening room.
1	20	Two 36-inch fans for dust exhaust. Preparing room.
1	35	One 40 and one 60-inch fan for dust exhaust. Preparing room.
1	15	Machine shop.
1	10	Freight elevator.
1	10	Coal conveyor.
1	10	Coal crusher.
1	20	Operating direct-current generator, furnishing current to bale hoist.

Gloucester (Mass.) Electric Company Expands.

The Gloucester Electric Company, Gloucester, Mass., has recently installed a 600-kilowatt alternating-current generator, direct-connected to a twin engine, each unit of which is of 375 horsepower rating, and has a cylinder of 18 inches diameter with 36-inch stroke. The machine operates at 150 revolutions per minute and produces 2,300-volt energy. The generator is capable of considerable overload, and has developed as much as 750 kilowatts for a short time.

The other generating units in use are a 600-kilowatt alternator, direct-connected to a twin engine operating at 120 revolutions per minute, and a 500-kilowatt vertical turbine.

The company's summer business is greatly in excess of that during the remainder of the year, owing to the fact that the territory served, outside the city of Gloucester, is given over largely to summer residences. The summer load is about 900 kilowatts and is fast increasing.

A five-mile transmission line carrying 4,400 volts serves an exclusive summer colony, the rate for residence lighting being high according to usual all-the-year standards, thereby compensating for the period of non-use of material on which an adequate return is properly earned. The Oceanside Hotel is another customer, taking 300 kilowatts.

In the opposite direction from Magnolia is the granite-quarrying town of Rockport. The industry is principally controlled by the Rockport Granite Company. Up to the present time compressed air, with steam plants in connection, has been the motive power for drilling in the quarries, cutting and polishing the stone. A central steam plant on the ground originally furnished the power for compressing, but as the industry increased several local plants were installed, in various locations as conditions demanded.

Now that some of the earlier equipment has become obsolete, the granite company is beginning to substitute electric power derived from the central station at Gloucester, and the Gloucester Electric Company has just closed a contract with the Rockport Granite Company to furnish power to 350 horsepower in motors for polishing processes. This is regarded as merely the initial installation, with complete substitution of central-station energy for private steam plants to follow in the course of time.

This type of business provides the best possible load for central stations, in that all the granite industry is closely limited as to working hours, and the plants are completely shut down at 4 p. m. daily, the power load never overlapping the regular lighting load even in the shortest days of winter. In Vermont, where the Montpelier & Barre Electric Light & Power Company furnishes energy for the operation of the great quarries and granite finishing works at Barre, the central station has found this type of load to be most advantageous, warranting a rate which, together with considerations of convenience, cannot be met.

Officers of Westinghouse Electric Export Company.

It is announced that at a meeting of the board of directors of the Westinghouse Electric Export Company, held in New York City, the following officers were elected: E. M. Herr, president; L. A. Osborne and Calvert Townley, vice-presidents; Maurice Coster, managing director; J. C. Bennett, secretary; H. D. Shute, treasurer; F. E. Craig, auditor; W. H. Jones, assistant secretary and treasurer.

President Herr announces the appointment of the following additional officers: E. D. Mills, manager; E. R. Ellis, European manager; H. F. Griffith, assistant export manager.

Commercial Practice
Management, Rates, New Business

Ohio New-Business Men Hold Important Convention at Sandusky.

How to better co-operate with the electrical contractors to increase the consumption of electrical energy and methods of disposing of refuse from woodworking plants, were among the important topics discussed by Ohio central-station men at a meeting of the Committee on New Business Co-Operation of the Ohio Electric Light Association, held at Sandusky on September 15. This was the first of a series of similar meetings to be held during the year, and is in accordance with the policy of the Association adopted two years ago, which has proven so successful. Representatives from the commercial departments of practically every Ohio company were in attendance, and much valuable discussion took place on the topics presented for discussion.

The delegates were welcomed to Sandusky by E. A. Bechstein, manager of the local central station, who spoke of the value of frequent meetings for the interchange of ideas among men engaged in the same line of work.

J. E. North, of Springfield, chairman of the committee, responded briefly. A paper was then presented by Thomas F. Kelly, of Dayton, entitled "How to Make Electrical Prosperity Week a Success." Mr. Kelly, after reviewing the general plans and organization in Ohio, for carrying out the work, made the following pertinent suggestions to central-station men: Get the electrical contractors and dealers interested, and tell them what Electrical Prosperity Week can be made to do in your town. Enlist the home chamber of commerce, the editors of local papers, and the city officials in your campaign. Put up electric signs and notices that the public may read. Include Prosperity Week "copy" in newspaper advertising. During the week before the celebration install festoons of lamps along the sidewalk and outline your building. Trim up your salesroom and windows in gala dress. On Monday of Prosperity Week hold an afternoon and evening reception, sending invitations to every customer, present or prospective. Provide music and a flower for every lady. Offer special easy-payment propositions to cover every appliance sold during Electrical Prosperity Week. Keep a register of every visitor to your display room. Get the merchants interested in outlining their buildings, temporarily if not permanently. Photographs perforated with pin pricks will demonstrate the effect. Carry the spirit of local festivity as far as possible. Install a slogan sign, if possible, with appropriate dedication ceremonies. Set apart one day, perhaps, as a local prosperity day. All of the suggestions can be carried out in any community.

A paper by A. E. Loeb entitled "Co-operation Between the Electrical Contractor and the Central Station" was then read by Chairman North.

In his paper Mr. Loeb takes the attitude that the buying public is fair. They want right service with as low a price as is consistent with value received. They are willing to pay a decent profit for a service performed, as long as they feel that the price is justifiable. The central station, however, has taken the path of least resistance, and instead of helping to maintain the electrical merchandising business on a paying basis, have tried to meet the popular demand for something cheaper, by cutting the price and taking the business at cost or less, with the hope of getting it back in current revenue, instead of injecting salesmanship into their proposition and convincing the public that they already were getting a square deal, and that the price was in line with good practice and service. So that now the public does not know whether the price is high or low, and think that whatever they pay is too much, and that there must be a lot of money in the business.

Continuing, he says: "The central station for its own good should if necessary go out of its way to assist and encourage the dealer, thereby adding another asset to its new-business department. If the dealer's prices are too high, go into the matter with him. Get into his confidence, get him to co-operate with you. Let him know that you want to be fair with him and he will be the best booster you have got in town. Help him keep down expenses. Let him have space in your office, charge him a nominal rate for rent. Help him to put on your house wiring and cooking appliances campaigns, and then see if he won't cut out selling gas fixtures, plants and the like.

"A great many central-station men have said that they could not get co-operation from dealers, and lay all the blame on them, but try and get their side of the story, and you will find in nine cases out of ten that they, too, have a grievance, many times justified that with a little diplomacy could be rectified and another good friend for the company gained.

In the discussion, Mr. Messer, of Kent, related the various experiences his company had had in connection with wiring work, and said they abandoned this business a few years ago. They now have in their city three contractors who take care of all the wiring, and the plan seems to be very satisfactory.

Mr. Maul, of the Ohio Service Company, stated that they had had considerable difficulty with contractors, and he thinks it was due, primarily, to the fact that the contractors were ignorant of the actual wiring work. He went to the contractors and had meetings at various times, and finally straightened out the difficulty. He made a careful canvass of the costs for wiring and established a standard rate for outlets. He called a meeting of the contractors and standardized methods of figuring wiring, and he said new business had increased very rapidly since they ceased wiring. Mr. Beebe, a Sandusky contractor, when asked his opinion on the subject, said that the contractors in Sandusky were well satisfied with the way in which the central station in that city had been treating them, and had no suggestions to offer.

E. A. Beckstein, of Sandusky, said his company had done some wiring several years ago, but they had entirely eliminated same, and that the contractors were handling the work very efficiently. He stated that they held meetings with the contractors quite frequently. Their company makes the contracts for wiring old houses, pays the contractor cash and carries the accounts for a year.

Mr. Hancock, of Youngstown, thinks the trouble in large cities is quite similar to the trouble in smaller cities, and suggested that the central stations ought to have a man who is capable of checking up and figuring wiring prices. He suggested also that a considerable amount of trouble would be eliminated if a standard handbook on wiring was used by all contractors. He claims he

has been in on various bids and maybe one bid would be approximately 100 per cent higher than another. He thinks it would be well to teach the contractors the proper way to figure out their costs.

Mr. Rust, of Greenville, said his company did wiring at this time, in order to hold prices within reasonable limits. He claims that the stock of the company in his city is all owned by the people there, and the people look to them to take care of their wiring in each and every case, and that they have no trouble at all with the contractors.

Mr. Yocoll, of Youngstown, said their company had trouble with the contractors getting together, and finally decided on a house-wiring proposition based on so much per house, with so many rooms and submitted the same to the contractors, and it has solved the problem for them. He claimed some of the contractors could not take this business, inasmuch as they claimed their costs were entirely too high, but other contractors in his city apparently have been very successful.

Mr. Beckstein referred to Mr. Yocoll's remarks, and said he thought the Youngstown Company was justified in sticking to their existing proposition, provided they could get the contractors to do the work at the prices made.

After luncheon an interesting address on 'Salesmanship" was delivered by Major C. B. Wilcox, chairman of the Board of Directors of the Sandusky Gas & Electric Company. The speaker mentioned the qualifications of salesmen for the electrical industry and made a plea for education of salesmen through organization.

At the afternoon session a paper entitled "Methods of Disposing of Refuse from Woodworking Plants" was presented by F. O. Alton, power engineer of the Columbus (O.) Railway & Light Company. This paper is published elsewhere on this page.

Crayon Factory Run by Central-Station Power.

The Amercina Crayon Company, of Sandusky, O., has recently contracted to purchase central-station power to the extent of about 300 horsepower, for its plant. Heretofore the company has generated its own electric power, but as its needs increased found it more economical and otherwise desirable to use central-station service.

The current is furnished by the Sandusky Gas & Electric Company (a W. S. Barstow & Company property), and is three-phase, 60-cycle, delivered at 220 volts. The American Crayon Company is the largest producer of school and industrial crayons in the world, and its principal plant is located in Sandusky. It also manufactures hardwood boxes for the general trade.

METHODS OF DISPOSING OF REFUSE FROM WOODWORKING PLANTS.

By F. O. Alton.

The subject of refuse disposal is one that the power engineer is always confronted with whenever a steam-driven woodworking plant is to be changed to electric drive, and a clear solution of the problem must be worked out, and presented to the manager before you can expect him to sign your power contract. To some managers this seems impossible to do, and the engineer then has a real chance to demonstrate his ability as a salesman and convince him that the refuse of his plant has a value, which in some cases equals the value of coal sufficient to run the plant, but this fact must not be referred to, because you will have all your work to do over again if he makes a change to coal. At the best it is like swapping dollars, but coal is easier to handle and safer.

There is one important factor in motor drive to be considered, and that is "the reduction in the insurance rate." This saving is sure to be 20 to 30 per cent on brick construction and 30 to 40 per cent on wood-frame construction. This saving, however, will vary in different places, and must be determined by a reinspection, and if capitalized to its full value will in itself solve the problem of disposing of the refuse, because the manufacturer can afford to give it away. This is never necessary, because it has a value which, however, is a variable factor, and all depends on the manufacturing interests near at hand, because it cannot stand transportation and handling costs, except when baled.

Clear sawdust can be used in a number of different ways. Large quantities are required by cold storage plants to absorb moisture on the floors and prevent foul odors, because they have no ventilation, and this precaution is necessary from a sanitary standpoint. Fruits, such as grapes, peaches, pears, etc., placed in cold storage are better protected when packed in sawdust. It is sold for about $2.50 per load of 2.5 or 3 cubic yards.

The chips and shavings are used for horse bedding, and find a ready market at the present time on account of the price of straw. It is also used for packing glassware and china and canned goods for shipment in barrels or boxes, and breweries use large quantities for packing bottled beer in barrels. The income from shavings and chips is usually from 22 to 25 cents per 80-pound bale.

The short ends and small pieces find a ready market the year around for fire wood, and this pile will never be more than the size of a wagon load, because there will be a waiting list if the manufacturer advertises at $2.00 a load.

It has often occurred to the writer that a good way to dispose of the refuse in small plants would be to find a man with a horse and wagon and sell to him at a fixed price and let him hunt his market. This would do away with all bother, and be a saving in the end, because all wagons are not the same size.

There is another way to dispose of the refuse by installing a dry kiln and burn this refuse to make steam to dry lumber. This result will be a big saving in a year's time, and is the method used at one plant in Columbus.

The Year Book of the Department of Agriculture, 1912, states that this country imported 5,000 tons of wood ash from Canada, valued at $66,000 which is proof that there is a market in this country. Wood ash that contains an average of 3.77 per cent potash is valued at $12.60 per ton.

The *Literary Digest,* of December 19, 1914, in the article on "Ashes as a Commodity," states that to convert wood ashes into potash figure six pounds equal to one pound of potash. As you all know, there has been a strong demand for a domestic supply of potash since the war started in Europe and our supply was cut off from Germany. The market price of potash was $35.00 per ton before the war, and it is $300 per ton today, so you can figure the value of wood ashes at the present time. They can be sold at the fertilizer plants for the value of the potash, determined by chemical analysis, and at a price far in excess of their value before the war. The visible supply of potash in this country is not sufficient to supply the demands of the fertilizer industries for more than this year's output and some new source must be found to meet the future demand of this established industry, and wood ashes offers the only supply of any magnitude at the present time, so a woodworking plant that uses its refuse for a dry kiln obtains two profits—first, the profit in the dry kiln and second the profit in the wood ash. It has been stated that if the total supply of refuse could be obtained and reduced to potash that we would not have to depend on Germany for this supply. This, in a general way, will solve the problem of the disposal of the refuse in woodworking plants, where the ordinary kinds of wood are handled.

We have in Columbus a plant that uses only two kinds of wood, 80 per cent of which is hickory and 20 per cent of ash. The refuse from this plant has been used as fuel for a steam drive, and this practice has been going

on for the past fifteen years, but at the present time this prospective customer has been convinced that an electric drive is by far the best, and an electrical installation will be made just as soon as the company has decided upon the best method of disposing of the chips and sawdust. These hickory chips and sawdust will be sold to one of the larger meat-packing houses in Columbus, as great difficulty has in the past been experienced in obtaining hickory wood for the "smoking" of their hams and sausage. The short lengths of wood are cut to sizes for wheel rims, spokes, broom handles and dowel rods. All short ends and pieces are to be sold for fire wood. The high potash value of hickory wood ash may be of sufficient magnitude to justify the reduction of this refuse to wood ash and dispose of it in the potash market.

This will serve to illustrate that each instance has its own peculiar problem, for which the engineer will invariably find a local solution.

Will Fight to Retain Electric Signs at Atlantic City.

Concerning the agitation started by certain interests in Atlantic City, N. J., looking toward the removal of all overhead and roof electric signs, Dr. Underwood Cochran, prominent broker and president of the Sane Sunday League, has announced his readiness to take the field at the head of an army of defense made up of Boardwalk property owners, and other interested citizens.

"Space for signs on top of buildings facing the Boardwalk," he declared, "rents for from $300 to $1,500 a year. I have heard it said that in one or two instances $2,000 is paid, but I do not believe it. This money is practically all velvet for the owners, for it involves no outlay whatever on their part. As for the charges made by Joseph W. Salus that the signs create fictitious values, I know that in one instance $800 derived from the rental of a sign space made it possible to take $200 per annum each off the rental of four stores and helped the lessees without doing the landlord any harm.

"And that isn't all by any means. Take down the signs and the city will have to spend $25,000 a year more than at present to make up for the lost illumination. The signs have been wholly misrepresented. They are not a menace. They cannot fall in any one direction, because they are braced."

The combined output of the electric light and power properties under the management of H. M. Byllesby & Company, for the week ended September 4, showed a gain of 16 per cent over the corresponding week of 1914.

SUCCESSFUL COMMERCIAL MANAGERS.

E. S. Marlow.

There is being held this week in Washington, D. C., one of the most successful conventions in the history of the Illuminating Engineering Society. Those who are in a position to know, unhesitatingly give credit for a large share of the success of this event to E. S. Marlow, chairman of the General Convention Committee, and manager of the commercial department of the Potomac Electric Power Company. Mr. Marlow has always taken a keen interest in illuminating engineering affairs, and has been, in a measure, responsible for many of the notable lighting installations made in Washington.

Serving a community in which manufacturing plants are practically unknown, and in which, therefore, the sale of energy for power is necessarily extremely limited, the Potomac Electric Power Company has had to extend unusual effort to increase its business among other classes of customers, and in this work the commercial department, under the direction of Mr. Marlow, has been particularly successful.

E. S. Marlow,
Manager, Commercial Department, Potomac Electric Power Company.

Washington is among the foremost cities in point of electric vehicles in use, particularly of the passenger variety, and this record is due to the activities of the local central station, as well as the Washington Section, Electric Vehicle Association, of which Mr. Marlow is chairman. In fact, he organized the Section, and has been instrumental in conducting a number of sociability runs, which have given great impetus to the electric in the National Capital.

Mr. Marlow started his electrical career as office boy and assistant bookkeeper for the United States Electric Light Company. This was over 30 years ago, in the days when Edison bipolar machines were in use, and when the opportunities for the sale of electricity were very limited. After serving the United States Electric Light Company in various capacities, Mr. Marlow was elected manager and treasurer, which positions he held until the consolidation of the United States Electric Light Company with the Potomac Electric Power Company. Since then he has been manager of the commercial department. Among other branches of work that come under Mr. Marlow's direction is that which looks after the sale of electricity.

Mr. Marlow is a member of the trade bodies of Washington, and a charter member of the Columbia Country Club. He is also a member of a number of technical and engineering societies.

Results of Safety Work at Columbus.

The Columbus Railway, Power & Light Company, Columbus, O., which, in the opinion of its officers ranks second to no other similar public service corporation in the country with respect to safety-first effort, is giving out some results along this line realized during the first six months of 1915. On January 1 of the present year its safety-first council became effective. This body is composed of committees from each department and sub-department of service, and is made up of men from the ranks as well as from officers and foremen. One of its duties is to pass upon suggestions invited from employees and from the public on greater efficiency and safety methods.

All told, 458 suggestions were received during the six months, of which 266 have been put into effect; 51 are being held for further consideration and 141 were disapproved. Of the latter class some were found excellent in theory, but could not be worked out in practice, owing to prohibitive expense or other reason.

Though the public is showing an increasing interest in this form of co-operation, the preponderance of suggestions came from employees. Some pertained to reforms of a very trivial nature, but were none the less welcome. Another activity of the council has been the constant posting of bulletins, covering all sorts of duties and emergencies.

It will take a longer comparative period to determine in dollars and cents just what the company is saving through its new safety policy, but officials approximate it at 60 per cent.

Electrical Construction

NOTES ON THE INSTALLATION OF MOTORS.

By M. F. Arloe.

The frames of all motors should be grounded, that is, connected to the earth by low-resistance substantial conductors, to minimize fire and life hazard. Motor frames should be grounded for the same reasons that dictate the grounding of generator frames.

Where frame grounding is impracticable, the frame should be thoroughly insulated from the earth. In this respect the practice is the same with generators as with motors. The generator frame should be either effectively connected to the earth or thoroughly insulated from it.

The wiring for motors should be installed in accordance with the same general rules that apply to inside wiring (that is, Class C, National Electrical Code) for electric lighting or other purposes.

The wiring for 550 to 3,500-volt motors should be done with multiple conductor, that is, duplex or triplex lead-sheathed cable, carried in metallic conduit. When this conduit is grounded the possibility of the high pressure imposed on the conductors creating a fire or increasing life hazard is much decreased for essentially the same reasons that grounding generator and motor frames and transformer secondaries decreases life hazard. Grounded metal sheaths should be used for incasing all high-tension apparatus for the same reasons. Approved bushings are used at the ends of such conduits because it obviously would be impracticable to carry the lead cable through the approved outlet boxes which are required at all conduit terminations in ordinary conduit wiring.

A high-tension cable-conduit outlet is shown in Fig. 1, which indicates the preferable method of terminating a conduit run which carries a high-tension lead-covered cable. In order to meet Code requirements, it is merely necessary to screw a standard conduit bushing on the end of the conduit so that the lead sheath of the cable will be protected from abrasion. However, it is probable that where the portion *A* of the sheath of the lead-covered cable is not protected by the iron conduit and is subject to mechanical injury, a metal sleeve extending from the conduit bushing to the cable pothead should be installed. Such a sleeve, which might be made of cast or sheet iron, brass or copper, can be made in two pieces and secured in place with a band.

The wires constituting the branch circuit serving one direct-current motor must be at least large enough so that they will carry, in accordance with Rule 18, 1.25 times the full-load current of the motor. For example, Fig. 2 shows a set of tap conductors *AB* carrying the current to one direct-current motor. Assume that the current taken by this motor at full load, as indicated by the name plate on its frame, or by computation, is 20 amperes. Then the wires composing the tap *AB* must be capable of carrying $20 \times 1.25 = 25$ amperes. Then (referring to Table A of Code Rule 18) a wire at least as large as No. 10 would have to be used if rubber-insulated conductor is to be utilized, or it would have to be as large as No. 12 if other insulation than rubber (Rule 18, Table B), such as weatherproof or slow-burning, is to be used. If the tap *AB* were quite long, it might be necessary to use wires considerably larger than those just specified in order to maintain the voltage drop within reasonable limits, but No. 10 or No. 12, respectively, would be safe from a current-carrying standpoint and are the smallest wires that should be used. The conductors must always be of such size that the fuses through which the current feeds to them will protect them in accordance with the requirements of Rule 18, and in no case should the main fuses be smaller than the fuses protecting the tap circuit to the motor.

When a number of direct-current motors tap from a main, as at Fig. 3, where the main is represented by *CD*, the wires composing each tap carrying the current of only one motor, as *E*, *F* and *G*, must

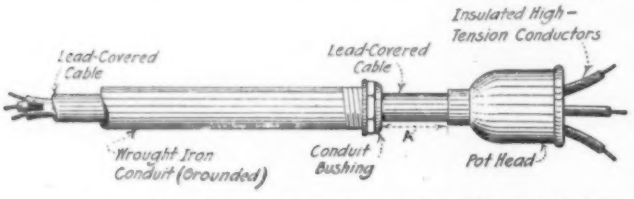


Fig. 1.—Bushing End of Conduit Carrying 550 to 3,500-Volt, Lead-Covered Cable.

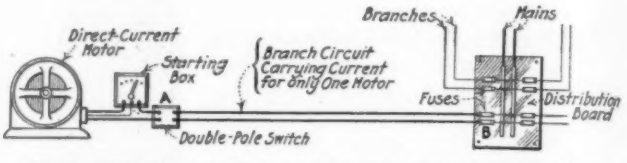


Fig. 2.—Protection for Tap Serving One Direct-Current Motor.

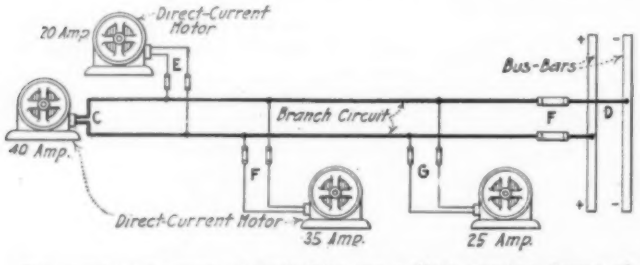


Fig. 3.—Arrangement of Protection for a Main Serving Group of Direct-Current Motors.

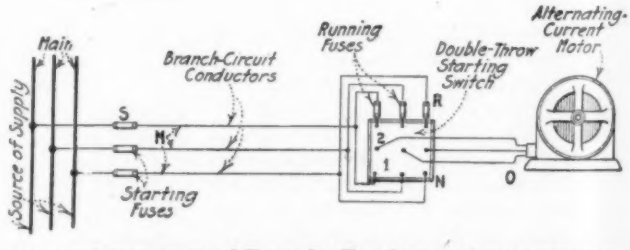


Fig. 4.—Arrangement of Fuses for Tap Serving One Alternating-Current Motor.

be large enough to carry (in accordance with Rule 18) a current 25 per cent greater than the full-load current of the motor. The wires used for the mains *CD* may be of any reasonable size, provided the fuses *F* which protect them are of such capacity that the wires *CD* cannot carry a greater current than is allowable under Rule 18.

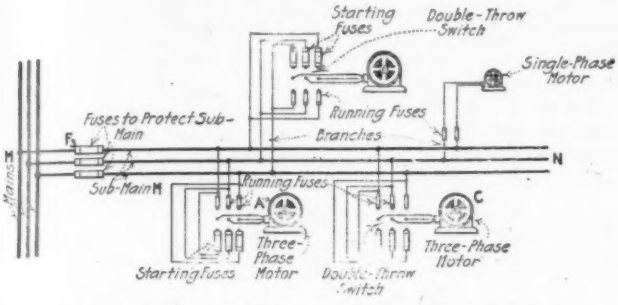


Fig. 5.—Overload Protection for Main Serving Group of Motors and Protection for the Motors.

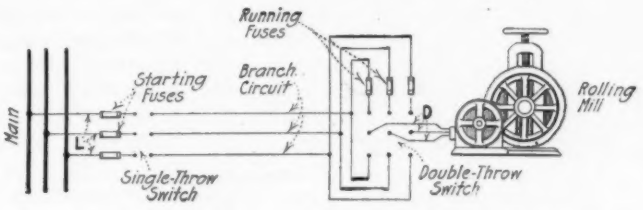


Fig. 6.—Overload Protection for Conductors Serving One Alternating-Current Motor Driving a Roll.

The usual method of determining a wire size for a direct-current motor main like that of *CD* which supplies several motors, is to add together the full-load currents of all of the motors and then assume that the current in the main *CD* will never exceed from possibly 60 per cent to 75 per cent of this total. For example, if the full-load currents of the motors of Fig. 3 were, respectively, 20, 30, 45 and 25 amperes, the current in the main *CD* would be, if all of the motors were operating at full load at the same time, 120 amperes. Experience has shown that it is seldom that all of the motors of a group will simultaneously draw their full-load currents. It is therefore allowable to use the "demand-factor." The demand-factor of an installation is the ratio of the maximum load which the installation imposes on the supply system, to the total connected load of the installation.

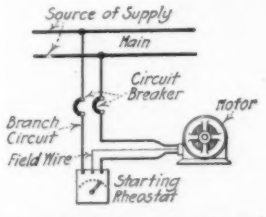


Fig. 7.—Circuit-Breaker for Overload Protection and Acting as Main Switch for Motor.

Assume a demand-factor of 75 per cent (a fair one for average direct-current conditions); then the main *CD* should be proportioned to carry $0.75 \times 120 = 90$ amperes, that is, with rubber-insulated wire (see tables of Rule 18) No. 2 should be used, and with other insulation No. 4. The main fuses at *F* should have a capacity of 90 amperes. In any case, the conductors must be of such size that the fuses through which the current feeds to them will protect them in accordance with the requirements of Rule 18. In no event should the capacity of the fuses which protect the main be smaller than the fuses protecting the tap circuit to any one motor.

The minimum permissible conductor size for a branch for one alternating-current motor may be determined as will be outlined. Practically all alternating-current motors have the characteristic of drawing much greater current, possibly two to five times as much, at the instant when they are first connected to the line as they draw after their rotors have attained full speed. Because of this fact special precautions should be taken in wiring alternating-current motors. Usually, for all except the smallest alternating-current motors, two sets of fuses, Fig. 4, are used. The starting fuses *S* must be of sufficient capacity to pass the starting current taken by the motor. If this starting current continued to flow for any considerable length of time in the motor windings, it would "burn them out," hence the starting fuses of themselves do not provide adequate protection for the motor. To protect the motor against excessive currents, after it has attained speed, running fuses, shown at *R*, Fig. 4, are inserted in the circuit.

Alternating-current motors are usually started by using a double-throw switch. Fig. 4, with unessential details omitted, shows the arrangement. The starting switch is first thrown to position *1* and current is forced through the motor which starts it, only the starting fuses being in series between the source and the motor. After the rotor has attained normal speed, the starting switch is thrown to the running position *2* and then both the starting fuses and the running fuses are in the circuit. The running fuses ordinarily have a capacity such that they will pass a current 25 per cent greater than the full-load current of the motor. All motors will carry a 25-per-cent overload for a considerable period. The starting fuses on the other hand frequently have capacities such that they may pass 200 per cent or more of the full-load current of the motor.

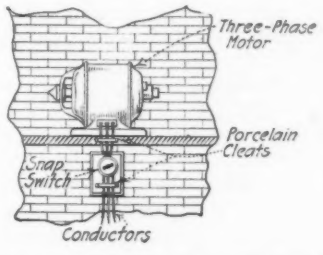


Fig. 8.—Small Motor Controlled by Enclosed Snap Switch.

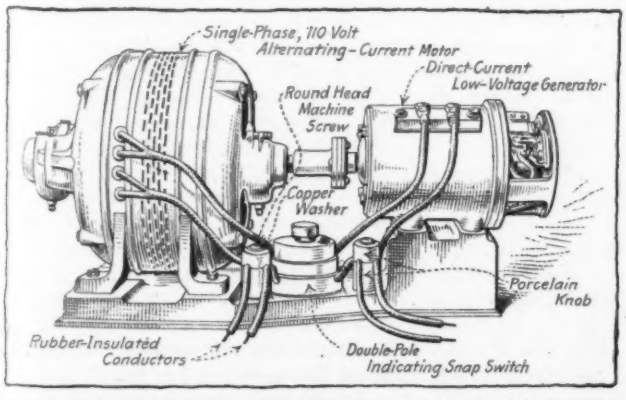


Fig. 9.—Snap Switch Used for Control of Small Motor-Generator Set.

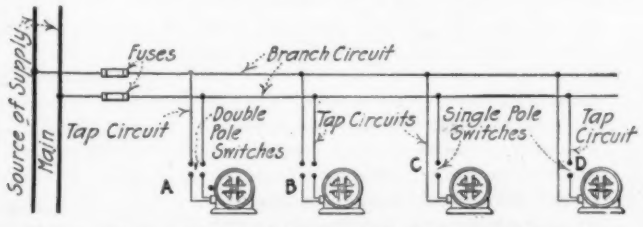


Fig. 10.—Group of Small Motors Protected by a Single Set of Fuses.

In selecting the wire size for a branch circuit for one alternating-current motor, the starting current taken by the motor un-

der the specific conditions of operation to which it will be subjected should be ascertained from the manufacturer or by experiment. Then the starting fuses (*S*, Fig. 4) must be selected of such capacity that they will pass this starting current. Then the branch-circuit wires, *M*, *N*, *O*, must be selected of such size that they will be protected, in accordance with the requirements of Rule 18, by the starting fuses *S*. Note that, according to

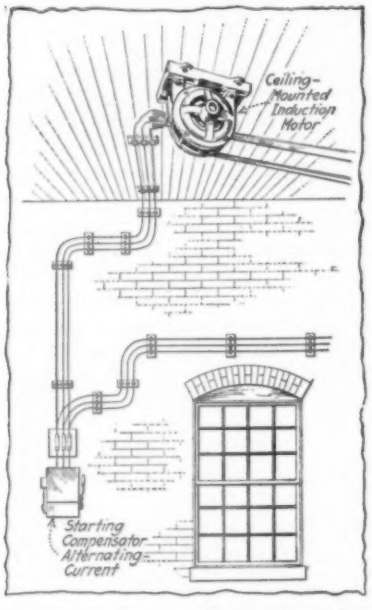


Fig. 11.—Open Wiring for Induction Motor.

Rule 8*c*, last paragraph, rubber-covered conductor branch circuits to alternating-current motors may be protected in accordance with the safe current values of Table B for insulations other than rubber, unless time-limit circuit-breakers constitute the overload protection provided for the motor.

For example, consider a motor that has a full-load running current of 20 amperes, and a starting current of 40 amperes. At *S* (Fig. 4) 40-ampere fuses would be used and with "rubber insulation" or with "other insulations" No. 8 wire (Rule 18, Table B) would be used for branch wires *M*, *N*, and *O*. No. 10 wire would not be large enough because it will carry safely only 30 amperes, whereas 40-ampere fuses must be used at *S*. The running fuses should be capable of passing a current about 25 per cent in excess of the full-load running current of the motor or 20 amperes $\times$ 1.25 = 25 amperes. Hence the running fuses *R* should be 25-ampere fuses. Note that starting compensators, or autotransformers, not shown in the illustration, are extensively used for alternating-current motor-starting equipments to minimize the starting current. The inclusion of such equipment in the circuit would not alter the principles outlined.

The determination of the smallest wire permissible for an alternating-current main serving several motors is made by practically the same method as that used in determining the permissible wire size for a direct-current motor main as described above, except that a greater demand-factor should be used. The maximum current that will normally flow in an alternating-current motor main as *MN*, Fig. 5, will probably in the average case be equal to from 45 per cent to 85 per cent of the sum of the full-load currents of all of the motors, that is, the demand-factor will range somewhere between 45 and 85 per cent. Where specific information is not available a demand-factor of 0.80 may be used.

Hence the fuses F_3 should be selected to have such capacity that they will pass the maximum line current thus determined, and the wires constituting the main *MN* must be of such size that the fuses will protect them in accordance with the requirements of Rule 18, Table A. However, if it is found that the current in *MN* is greater than was anticipated and it is necessary to increase the sizes of the fuses F_3 to enable them to pass the normal running current in the main, new conductors for *MN* must be selected of such size that the new fuses will reliably protect them.

In no case, however, should the fuses at F_3 be smaller than the starting fuses for any one of the motors. The conductor and fuse sizes for the branch to each motor may be determined by the method described in the preceding paragraph.

In determining wire sizes for taps or branches for varying-speed motors the fact that the current taken by the motors is subject to extremes of variation must be considered. It is seldom the case in practice that the current of a varying-speed motor is constant. The nature of the loads and the characteristics of the motors are such that the power output

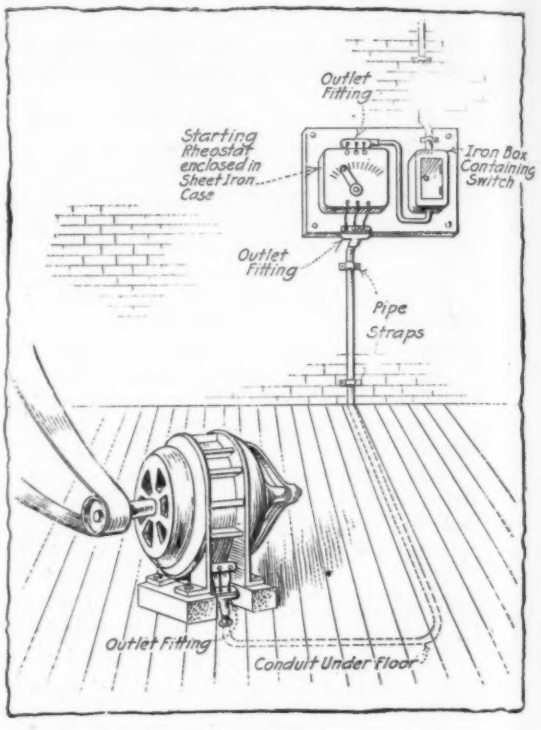


Fig. 12.—Motor Wiring Installed in Conduit.

of the motor and the current input may be zero at one instant and a maximum after a short interval later, hence it is undesirable to rate these motors on the basis of the horsepower output they will deliver continuously. Instead, they are usually rated in the basis of their output for 30 minutes. Obviously a motor will have a greater power output on the basis of its 30-minute rating than it will on the basis of a continuous rating because the power that any electrical machine can deliver is determined to a considerable extent by the heating of the machine. The temperature at no part of the machine should ever exceed a certain maximum, usually about 100 degrees centigrade, or 212 degrees Fahrenheit. It is apparent that the machine can carry a greater load for 30 minutes without its temperature exceeding 100 degrees centigrade than it can continuously. It is for these reasons that constants must be used in determining the wire size for varying-speed motor leads.

For example, consider the case of Fig. 6, where the rolling-mill motor on the basis of a 30-minute rating takes 100 amperes. Then leads *LD* would have to be of such size that they would safely carry at least 100 amperes $\times$ 1.50 = 150 amperes, where "1.50" is the constant.

Potheads should be provided on high-tension motor cables to prevent injury to

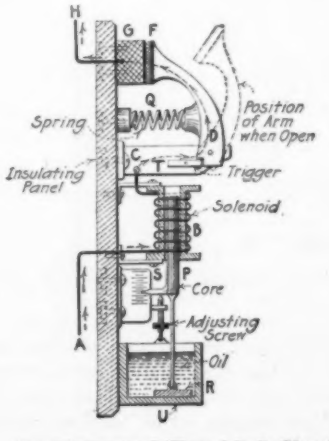


Fig. 13.—Diagram of Time-Limit Circuit-Breaker.

the conductors. There is always danger of moisture entering the cable or of the insulation of the conductor becoming cracked at the point where it leaves the cable unless a pothead is provided. All conduits and metal protective casings of the high-tension insulation should be electrically interconnected, that is, connected together, so that there can be no difference of potential between the parts and so that all protective metal parts will be connected to ground.

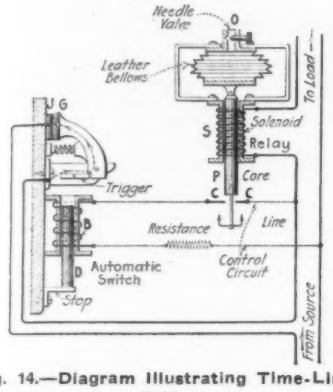


Fig. 14.—Diagram Illustrating Time-Limit Relay.

The protective and starting devices in the branch circuit to a motor are shown in Fig. 7. In the illustration a circuit-breaker is shown in lieu of fuses, circuit-breakers being acceptable under certain restrictions, as indicated below, and they are preferable to fuses in certain cases.

Switches indicating whether they are

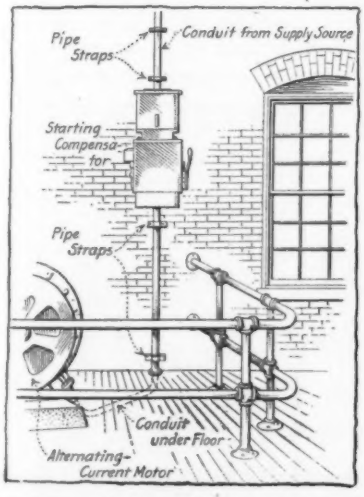


Fig. 16.—Protective Railing Around Motor and Starting Device.

on or off are procurable in several types. A knife switch which is exposed to view obviously indicates whether the circuit it controls is closed or open, and indicating snap switches or flush switches, Figs. 8 and 9, give the same information. Fig. 9 shows a Wagner battery-charging motor-generator. The motor input and the generator output is less than 660 watts, hence a double-pole snap switch is used, one pole cut in the generator circuit and the other pole in the motor circuit. Connected in this manner the one double-pole switch is equivalent to two single-pole switches.

A group of small motors may be protected by a single set of fuses, where the total load does not exceed that (660 watts) ordinarily allowed on an incandescent lighting circuit. Fig. 10 shows a group of small motors so protected, the entire group being fed through one set of fuses. Note that small motors where the power output does not exceed 660 watts may be controlled either by a double-pole switch as shown at *A* or *B*, or by a single-pole switch as shown at *C* and *D*.

The switch and rheostat should be located within sight of the motor so that the operator in starting or stopping the motor will observe the motor's performance when he operates the switch or starting device. Furthermore, they should be so located that if any difficulty with the motor occurs it can be readily stopped. Fig. 11 shows an open-wire installation for an alternating-current motor arranged in accordance with this requirement, while Fig. 12 shows a similar installation for a direct-current motor where the wiring is in conduit.

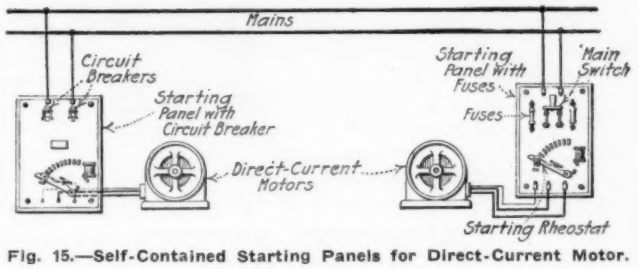


Fig. 15.—Self-Contained Starting Panels for Direct-Current Motor.

Circuit-breaking devices disconnecting all wires of the motor circuit are frequently incorporated in control equipments, such as those for elevators and other automatic controls. These devices perform all of the functions of a switch and hence may be used in lieu thereof.

Overload-release devices on starting rheostats as a rule do not provide adequate overload protection because they are frequently of frail construction and in any case do not provide protection to the portion of the motor branch circuit between the starting device and the main.

Automatic circuit-breakers perform the functions of both fuses and switch where the breaker disconnects all of the wires in a circuit, as in Fig. 7. This means that if a circuit-breaker is to be substituted for the fuses and a switch in a two-wire motor circuit, that a two-pole breaker must be used, or on a three-wire three-phase circuit a three-pole breaker should be installed.

Rubber-covered conductors serving alternating-current motors may be rated as to current-carrying capacity in accordance with the currents allowable for insulations other than rubber (Rule 18, Table B). The reason for this is that the starting current for such motors is much greater than the running current. But inasmuch as, under normal conditions, the starting current flows for only a short period there is no danger of overheating the conductor and thus damaging its insulation, even if a liberal current-carrying-capacity rating is allowed. Consider an example, Fig. 4. Assume that the branch circuit to the motor is to be of rubber-insulated wire and that the starting current taken by the motor is 100 amperes. Ordinarily, according to Rule 18, No. 1 rubber-covered wire should be used to carry 100 amperes, but in the case of the branch to one alternating-current motor, No. 3 rubber-covered wire could be used because No. 3 wire with insulations other than rubber will safely carry 100 amperes (Rule 18, Table B).

Time-limit devices are arrangements whereby a circuit-breaker is prevented from opening on a sudden overload, but which permit the breaker to open if the overload is continued. Fig. 13 illustrates the principle of one type. With the breaker closed, the current enters at *A*, passes through the solenoid *B* and continues via course *C*, *D*, *F*, *G* and *H*. When current flows, the solenoid *B* is energized. When a current smaller than that for which the breaker is set at *S* flows through the breaker the attraction of the solenoid is not sufficient to lift the disk *R* and the iron plunger *P* and draw it up into the solenoid. However, if the current becomes greater than that for which the breaker is set, the magnetic attraction then overcomes these restraining

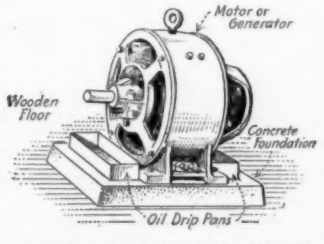


Fig. 17.—Drip Pans to Catch Surplus Oil from Motor Bearings.

effects and the tendency is to pull the plunger up into the solenoid until it strikes the trigger *T* which will release arm *D*. Then the spring *Q* will force the arm out to the position shown in dotted lines, opening the circuit. However with the time-limit circuit-breaker, the plunger is prevented from rising immediately because of the restraining action of the time-limit device (*U* and *R*) due to the cohesion of the smooth bottom

of the disk *R* to the bottom of the cup *U*, which contains oil. But, if the overload persists, the continued pull exerted by the solenoid on the plunger will overcome the cohesion between the disk and the bottom of the cup and it will then permit the plunger to rise and the circuit-breaker will be opened. Note then, that although the breaker of the type diagrammed in Fig. 13 will open under an overload that lasts for several seconds it will not open under a momentary overload.

Fig. 14 illustrates the principle of a time-limit circuit-breaker of another type. With this device the main current, or a certain definite portion thereof, circulates around the solenoid *S*. If this current becomes greater than that for which the instrument is set, the plunger *P* of the solenoid tends to rise. It is, however, restrained from rising abruptly by the leather bellows which must force the air it contains out of its air chamber through the small orifice *O* before the plunger can be raised any great distance. However, if the pull on the plunger due to the solenoid *S* is continued, the air will be forced out of the bellows, the plunger will rise, and the contactor *CC* will close the auxiliary circuit permitting current to circulate around the solenoid *B*. Then the plunger *D* will be attracted and the breaker will be tripped, opening the main circuit at jaws *J* and *G*. Figs. 13 and 14 are merely diagrams to illustrate the principles involved in the operation of these devices and are not intended to show their actual construction or exact proportions.

Starting panels for direct-current motors are shown in Fig. 15. On these panels is mounted all of the equipment required for protection and starting of the direct-current motors. Panels such as these provide neat installations because they eliminate the necessity of wiring between protective devices, switches and rheostats. They are very simply installed, inasmuch as where they are used it is only necessary to carry two conductors to the line side of the starting panel and to run three conductors from the motor side of the starting panel to the motor.

Most autostarters are now provided with casings which inclose all current-carrying parts. In some makes of autostarters the cutout arranged to receive the fuses has bare current-carrying parts, and in such instances this cutout can be inclosed in a metal cabinet.

Railings should be provided around motors where there is any possibility of accidental contact with either the bare current-carrying parts of the motor or its starting device. A typical installation thus provided with a railing is shown in Fig. 16.

Motors located in wet, dusty or dirty places should ordinarily be inclosed either in a ventilated inclosure or in a room, Fig. 18, prepared for their reception. The room should be big enough so that the attendant can work around the apparatus without difficulty and it should be provided with windows and artificial lights; where there is danger of fire the windows should have wire glass. Where the motor is suspended from a ceiling, a room can be arranged around it by providing glass partitions from the floor of the motor platform to the ceiling. It is seldom necessary to inclose alternating-current motors of the types in which brushes are not used, such as squirrel-cage induction motors.

Enclosed motors have the advantage that all dust and dirt is excluded, but they have the disadvantage that inclosing a motor or any electrical machine, as shown in Fig. 19, *II*, so decreases the ventilation that the capacity of the motor is materially reduced. For example, if a motor has a capacity of 15 horsepower when open as shown in Fig. 19, *I*, the same motor enclosed, as shown at *II*, may have a capacity of only 7 horsepower. Where it is desired to protect the working parts of the motor from mechanical injury rather than from finely divided particles, perforated covers *IV* can be used instead of the solid inclosing covers *III*, without materially decreasing the output of the motor. As noted above it is seldom, if ever, necessary to enclose alternating-

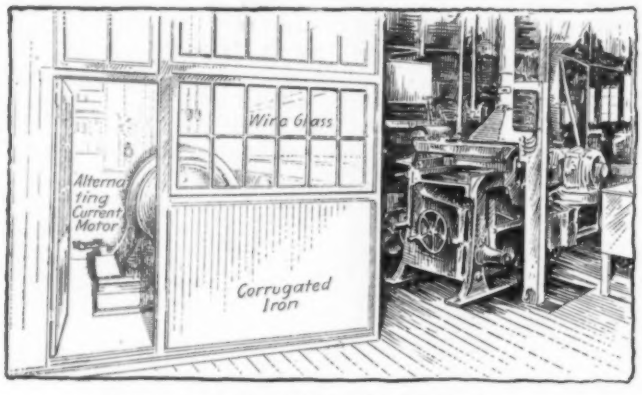


Fig. 18.—Fireproof Motor Compartment.

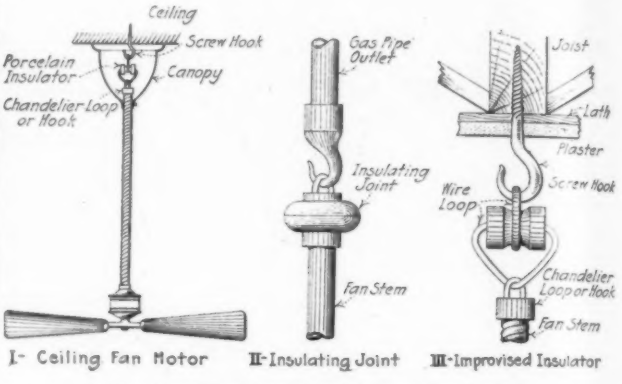


Fig. 20.—Method of Insulating Ceiling Fan Motors.

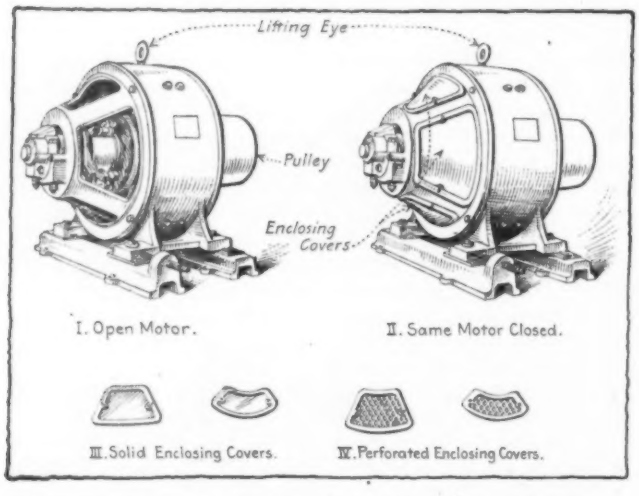


Fig. 19.—Motor Open and Provided With Enclosing Covers.

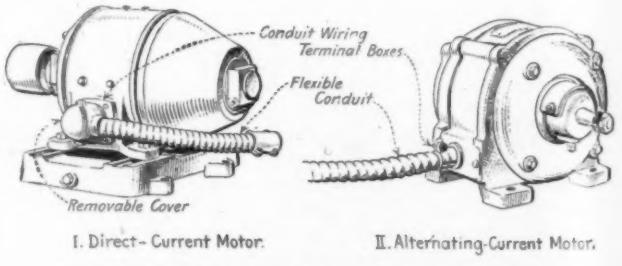


Fig. 21.—Conduit-Wiring Terminal Boxes on Motors.

current motors of the types that do not have brushes.

Oil-drip pans may, where necessary, be provided as shown in Fig. 17 to catch any oil that may drop from the bearings. Such oil, if allowed to fall on and soak into a wood floor or other combustible materials, would greatly increase the fire hazard. It is seldom that it is necessary to provide modern motors with drip pans, inasmuch as their bearings are so designed that the oil does not ordinarily leak from them.

Ceiling fan motors should be insulated

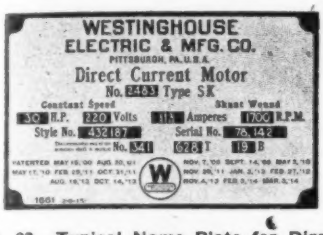


Fig. 22.—Typical Name Plate for Direct-Current Motor.

from the ceiling as shown in Fig. 20, so that there will be no possibility of a leakage current to ground, causing a fire. The frames of ceiling fan motors are always thoroughly insulated from the supporting surfaces, inasmuch as it is not usually practical to ground them like it is the ordinary motor and generator frames.

Typical motor name plates are shown for a direct-current motor and for an alternating-current motor in Figs. 22 and 23, respectively. These name plates give information similar to that given on generator name plates and are required for the same reasons. The authoritative data that they provide tends to prevent the

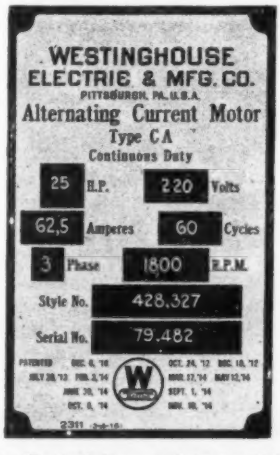


Fig. 23.—Typical Name Plate for Alternating-Current Motor.

possibility of the overloading and consequent overheating of the machine.

Terminal blocks on motors perform essentially the same function as those on generators and hence are similarly constructed. Where motor wiring is to be installed in conduit it is always desirable to secure motors provided with terminal boxes, Fig. 21, arranged for conduit wiring. Where these boxes are used, all of the conductors are enclosed and there are no loose ends or "pig tails" to catch dirt and lint.

All direct-current motors should be so wired that the field will be excited before current flows in the armature circuit of the motor. The armature of a direct-current motor (Fig. 24) has a very low resistance, hence if the normal electromotive force of the circuit is impressed upon it (with the armature stationary) a large current will flow which will probably melt fuses, and might, under some conditions, cause a fire due to overheating of certain parts. However, if the motor armature rotates in a magnetic field there is induced in it a counter electromotive force. When the armature of a direct-current motor rotates in its magnetic field, this counter electromotive force is always in such a direction that it opposes the external electromotive force which is applied to the motor and which causes rotation, and thus the current through the armature circuit is limited to a safe value. It is

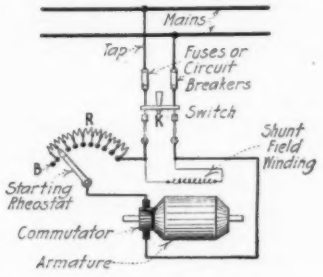


Fig. 24.—Diagram to Show Correct Method of Connecting Motor so that Shunt Field Will be Excited Before Current Flows in Armature.

apparent then that if the armature of a motor is connected across a supply circuit, the field circuit of the motor not being excited, the supply conductors will be short-circuited. But if the field of the motor is first excited and then the armature is connected across the supply circuit, it will at once commence to rotate and induce the counter electromotive force which will limit the current through it. However, resistance, *R*, Fig. 24, should always be provided, in series with the supply circuit and the armature, to limit the current through the armature at the instant of starting. As the armature attains speed, this resistance can be gradually decreased until finally when the armature has attained full speed it may be connected directly across the line. Note in Fig. 24, when the motor is not operating, knife switch *K* should be open and the rheostat handle should be on button *B* so that the armature is not in circuit. Then in starting the motor, *K* is closed. This permits current to flow immediately through the shunt-field winding. No current can flow through the armature until the rheostat handle has been moved one button to the right. Then a small current will flow through the armature, but when it does flow the field will be excited and the armature will commence to rotate.

Bushings for motor leads should be of non-absorbent and preferably of non-combustible materials for the same reasons that such materials are desirable for generator bushings.

New York City Board for Examining and Licensing Electricians.

Pursuant to Chapter 9 of the Code of Ordinances of the City of New York, Commissioner William Williams, of the Department of Water Supply, Gas and Electricity has appointed the following-named persons, all of New York City, as a board to determine the fitness of applicants for licenses to be issued pursuant to said chapter in relation to installing, altering or repairing electrical wiring or appliances for light, heat or power in buildings:

Hubert S. Wynkoop, chairman, electrical engineer, Bureau of Gas and Electricity, Municipal Building.

John P. Ryan, employing electrician, 26 Cortlandt Street.

Paul McNally, journeyman electrician, 63 Park Row.

Joseph C. Forsyth, Underwriters' electrical inspector, 123 William Street.

Arthur A. Pope, electrician, New York Edison Company, Irving Place and Fifteenth Street.

Fred G. Webber, builder, 29 West Thirty-fourth Street.

Elmer D. Coulter, real-estate owner, 23 West Twenty-sixth Street.

This board will proceed at once to the formulation of rules and regulations governing the issuance of licenses, which will be published.

Among the Contractors.

The largest electrical contract awarded in Baltimore, Md., during the present year, was recently given to the E. S. Downes Company, of Philadelphia. The contract was for the wiring of the new grain elevator erected by the Western Maryland Railroad at Port Covington, which is just outside of Baltimore. This is the first grain elevator in that vicinity to be operated by electric power and the motors represent a total of 1,500 horsepower.

J. F. Shore & Son have opened a new electrical shop and repair department at 507 West Third Street, Davenport, Ia. The company will undertake electrical contracting of every description.

H. J. Mullen has opened an electrical store and repair shop at 213 College Street, Burlington, Vt. In addition to the repair shop a complete line of electrical supplies will be displayed on the first floor and storage batteries will be repaired and recharged.

Public Service Commissions

Conducted by William J. Norton

INDIANA.

The Interstate Public Service Company was authorized to issue $23,000 par value of bonds to reimburse the treasury of the company for expenditures made on account of underlying bonds of the Corydon light and water plant, and on account of expenditures for betterments and purchase of new properties and equipment, between May 1 and July 31, 1915. The bonds are to sell at not less than 80 per cent of par.

The Central Indiana Lighting Company was authorized to issue $14,000 of bonds to reimburse its treasury for $3,000 expended in the retirement of underlying bonds of the People's Gas, Electric & Heating Company, and $11,000 for extensions and betterments made in the cities of Bloomington and Columbus.

The City of Greenfield was granted authority to put in effect reduced rates for electric service furnished by its municipal plant. The former schedules provided rates of 10 cents to 6 cents per kilowatt-hour for light, and 4.5 cents to 2.5 cents a kilowatt-hour for metered power. The new rates are graded from 7 cents to 2.25 cents per kilowatt-hour.

NEW YORK—Second District.

The Depew & Lancaster Light, Power & Conduit Company was authorized to issue $49,000 of its 5-per-cent bonds at not less than 80, to net $39,200, to be used in the construction of its distribution plant in the town of West Seneca.

OREGON.

The Hood River Gas & Electric Company and the Hydro-Electric Company applied for and were granted permission to substitute a straight prompt-payment discount of 10 per cent of the amount of the customer's bill for the discount provision in their schedules, as fixed by the former order of the Commission, issued July 14, 1915. (ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, July 31, 1915, page 191.) The former order provided a discount of one cent per kilowatt-hour for the first 30 kilowatt-hours and one-half cent for each kilowatt-hour over 30 for payment within ten days from date of billing. The Commission says the proposed straight discount is substantially the equivalent of that prescribed, and "will apparently be more convenient for the utilities."

Eastern Oregon Light & Power Company. In reply to an inquiry as to whether or not newspapers may lawfully be given a rate for electric current used by them in the operation of their electrical machinery which differs from the published tariff, the Commission handed down a general conference ruling which reads in part as follows:

"The act (Public Utilities Act) permits certain concessions in favor of specified classes of persons. Newspapers do not appear to be named by the Legislature as entitled to such specific consideration.

"The act, as a whole, contemplates that utilities may classify their customers. Whether the character of service furnished the newspapers is so different from that contemplated in the existing classes of customers provided in the company's tariffs does not appear, and, therefore, no opinion is expressed thereon. Manifestly any classification of customers should be based upon service conditions, so that it would be applicable to all customers who may have similar load and service characteristics."

WISCONSIN.

Washington County Telephone Company. In an investigation to determine proper rates to be charged by the Washington County Telephone Company, it appeared that the company's investment was somewhat larger than is the usual investment for companies operating somewhat similar systems. It developed that the company had purchased the property of a competing concern which was operating in practically the same territory and paralleling its lines in many cases. The amount paid for the property was, apparently, considerably more than the reasonable value of the property. Moreover a large part of the property was scrapped in eliminating duplications which existed under competitive conditions. The Commission says: "Whether the applicant credited its property and plant account with the cost of portions of its property which were scrapped, the evidence does not show, but the rather high book value of the property would seem to indicate that the property and plant account had not been credited with the cost new of property removed from service."

Consideration is given the fact that better service was secured by the consolidation of the properties.

"That the long-distance connection thus obtained, and the elimination of duplication were of sufficient value to the general body of subscribers to justify the company in charging rates at the present time sufficient to meet the fixed charges on its entire investment, a very large part of which is not represented by tangible property at the present time, is not clear from the records before us. That there have been certain advantages to subscribers from the unification of the telephone systems and the ability to secure long-distance service, there appears to be no reason to doubt, but we do not feel that the book value of the property representing, as it does, a large investment made necessary to eliminate a competing company from the field, and probably a large investment also in physical property which has been discarded, can be accepted as controlling for the purpose of this case.

"It is true that under the present laws physical connection may be secured between telephone systems wherever reasonably necessary, but such connection, even at the best, is not likely to be equivalent to service of equal extent furnished by a single company. The company has undertaken to furnish this more valuable service, and although a part of the fixed expenses resulting from the consolidation should probably not be thrown back upon subscribers, but should be considered as a loss to the company, resulting from its having operated in a competitive field, it seems to us to be reasonable to expect that subscribers should bear a portion of the fixed expenses which were incurred in eliminating a condition unfavorable to good telephone service."

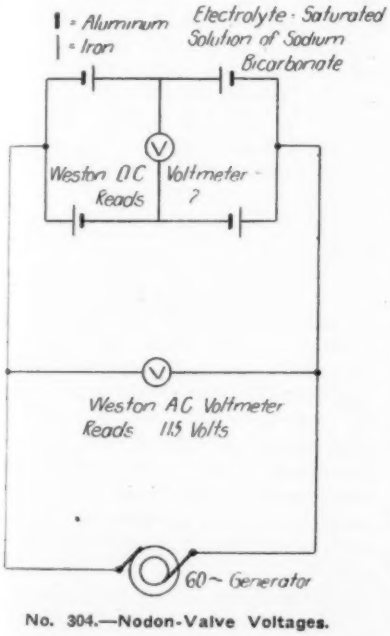
The Interborough Rapid Transit Company, New York City, has received 61 all-steel cars for subway service. This is the first part of an order for 478 steel cars to replace cars with composition car bodies. The older cars, as they are replaced, will be put in service on the elevated lines.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 304.—Voltages With Electrolytic Rectifier.—In the diagram given of a Nodon valve (electrolytic rectifier) I find by actual test that the direct-current voltmeter reads higher than the alternating-current voltmeter. Theoretically, as I reason it, the alternating-current voltmeter should read approximately 0.7 of the maximum ordinate of the sine curve of E. M. F. and the direct-current voltmeter should read approximately 0.6 of the maximum ordinate of the same sine curve of E. M. F. Please explain why the direct-current voltmeter reads higher than the alternating-current voltmeter. To give a concrete example, suppose the alternating-current voltage applied to a Nodon valve, as shown in the diagram, be 115 volts, what will the rectified direct-current voltage be?—A. G., Fort Monroe, Va.



No. 304.—Nodon-Valve Voltages.

No. 307.—Special Type of Induction Motor.—A new type of induction motor has been invented in which the bars of the squirrel-cage rotor are made of special composition possessing characteristics which automatically limit the starting current. Has this construction been applied to any large motors and is it effective in operation?—C. M. D., Gary, Ind.

No. 308.—Aluminum Solder.—Can aluminum wire be soldered and what is the best way for doing it, if it can be done?—S. H. L., Joliet, Ill.

No. 309.—Automatic Cutout.—It is desired to keep an electric water heater taking 550 watts in circuit as continuously as possible. A few other devices and lamps are also on this circuit, but are turned on for short intervals only. Is it possible to devise some automatic means for temporarily cutting out the heater while the other load exceeds one ampere? The device must reconnect the heater as soon as the other load is cut off or reduced to less than one ampere.—V. B., Milwaukee, Wis.

Answers.

No. 303.—Rewinding Motor for Lower Frequency.—I have a three-phase, 220-volt, 60-cycle, three-horsepower motor which runs at a speed of 1,750 revolutions per minute. I wish to use this motor on a 25-cycle circuit and do not need more than two horsepower. I would be glad to know through the columns of your paper how I could wind this motor to gain this result. What would be its speed and would its efficiency still be high? At the present time it starts under full load with a high degree of torque and I would rather not change it unless I was certain of equally satisfactory results.—F. I. R., Auburn, N. Y.

The motor in question will hardly be able to give at the reduced periodicity of 25, an output of two horsepower. Since the present rated output is three horsepower at 1,750 revolutions per minute corresponding to 60 cycles and the speed at 25 cycles will be 725, the rated output would be normally $3\times725/1{,}750=1.25$ horsepower. This would mean the motor will run constantly under 60 per cent overload. But as iron losses are materially lower at 25 cycles, the total magnetic flux at present existing could easily be increased by about 15 per cent; this would increase the available normal output to 1.45 horsepower, which means still a continuous overload of 38 per cent. It is a question whether the slots are big enough to permit a section of copper for the new stator winding which does not result in too high a temperature rise when running at two horsepower permanently. It is assumed that the motor has a squirrel-cage rotor which will not be changed.

The actual magnetic flux can be determined from the well known equation

$$\Phi=(E\times10^8)/(2.12\times Z\times C),$$

where E is the voltage per phase,

Z the number of effective wires in series per phase,

C the number of cycles.

Z can be ascertained by counting the number of wires per coil as at present existing. The voltage at 25 cycles is assumed to be again 220 volts between phases. From the above we get for the flux

$$\Phi=(1.27\times10^8)/(2.12\times Z\times60)=10^8/Z.$$

The number of wires for the new condition by admitting 15 per cent more flux will be therefore,

$$1.15\Phi=(1.27\times10^8)/(2.12\times Z_1\times25)$$
$$\Phi=2.08/Z_1.$$

This means the new number of wires is to be double that existing. The section of the wire can be taken to 65 per cent less than the actual present section, which would mean at 10 per cent continuous overload, which even under the reduced ventilation due to the reduced speed would not given rise to injurious heating. It is hardly possible, however, that the slot dimensions will permit of bringing in double the number of the present wires with the new section, as the space-factor on account of the thinner wires is worse, the insulation taking more space. The best would be to try what diameter can be placed in the slots with the new number of wires; this would indicate what output the motor under the new conditions can give, namely:

New output=old output×ratio of new section of wire to old section×1.15.

The foregoing calculation is based on the assumption that the present number of four poles is maintained. In this case the new efficiency for 1.45 horsepower will be about 5 to 7 per cent lower than before at three horsepower. The same holds for two horsepower approximately. The starting conditions are also approximately the same as before; although the electromotive force induced in the rotor is about one-half, on account of the double number of windings per phase in the stator, the flux has been increased somewhat. At this lower speed the torque would be higher for two horsepower; it is likely, however, that the shaft and bearings are strong enough for the increased rating.

Another possibility would be to run the motor with double this speed, that is 1,420 revolutions per minute, by reducing the number of poles to two. The normal output is then 2.5 horsepower, which is sufficient for the new requirement. The number of wires remains the same as calculated for four poles, but they are to be distributed in two poles instead of four; that is, the present number of slots per pole per phase is simply doubled. Such two-pole winding, of course, takes more room in the end connections which might not be available on account of the present brackets.—H. A., Pittsburgh, Pa.

A 60-cycle three-phase induction motor of 1,750 revolutions per minute is wound for four poles and when connected to a 25-cycle supply of equal voltage will develop a considerable higher starting torque than with 60 cycles. The increase in torque is due to the increase in flux in the proportion of 60 to 25; but while this increases the torque, it unfortunately also increases the current required for the generation of this magnetic flux and the current taken by the motor, when running idle on 220 volts, 25 cycles would be so high as to heat the motor unduly.

This would be obviated by reducing the

supply voltage in the proportion of the frequencies of 2 5to 60. The rating of the motor would be then 1.25 horsepower, 25 cycles, 92 volts, 720 revolutions per minute. In order to obtain this odd voltage a three-phase autotransformer could be used. The cost of this arrangement would be lower than rewinding the motor; the efficiency would be scarcely 2 per cent lower than that of the motor after rewinding.

If, however, rewinding is preferred the number of wires per slot required is 60/25=2.4 times that at present in the slot. The starting torque of the motor would be good, but not so abnormally high as at present, its efficiency naturally 1.5 to 3 per cent smaller than that of the three-horsepower motor.

If this output and speed is not satisfactory then the number of poles will have to be changed. This is only practicable if the end bells of the bearing brackets have still sufficient room to hold the somewhat larger coil ends of the two-pole motor. The coil ends would be about 40 to 50 per cent larger, measured from the stator core in the axial direction. In order to keep the coil ends as short as possible and also for electrical reasons it would be advisable to make the throw not half the circumference, but somewhat less; with 36 slots about 1 to 16, or with 48 slots total 1 to 21. This, however, can only be done conveniently if a two-layer winding (two sides of a coil per slot) can be put into the slot. The output of the two-pole motor is about double that of the four-pole motor, so that the motor would be wound for 2.5 horsepower. In order to go safely, however, as the full data of the motor are not available, and as to the induction at the back of the stator teeth is doubled by the widening of the poles to double width, we will reduce the magnetic flux corresponding to the output of two horsepower, as required.

The rating of this motor would be two horsepower, 220 volts, 25 cycles, 1,450 revolutions per minute. The number of wires per slot would have to be $60/25 \times 2/4 \times \sqrt{2.5}/2 = 1.34$ times the number of wires wound in the existing motor.

The efficiency of this motor would be equal to that of the three-horsepower, 60-cycle motor and its starting torque in percentage of full-load torque superior, as the rating of the motor is not limited by the overload capacity, but by heating in this case. Provided that the dimensions of the motor brackets will allow of the longer coils, the rewinding would prove thoroughly satisfactory.—J. J. W., Pittsburgh, Pa.

No. 305.—Test of Ground Plates.—What is the best way to test the effectiveness of ground plates?—F. A. H., Chicago, Ill.

The usual way of determining the effectiveness of an earth or ground is to measure the resistance between it and an extremely good ground, such as a water main, penstock, etc. A better way is to have two additonal earths beside the one whose resistance it is desired to determine. The resistance is then measured between each pair of earths, from which the resistance of each is calculated as follows:

(1) $R_1+R_2=A$,
(2) $R_1+R_3=B$,
(3) $R_2+R_3=C$,

where A, B, C are the resistances found by measurement, and R_1, R_2 and R_3 the individual resistance of the earths. Strictly speaking, an earth connection has not a definite value of resistance, but it has one that is approximately so if the earths are isolated from each other. The reason for this is on account of the major portion of the resistance occurring at the contact surface of the ground plate or pipe. To prevent large errors, and even ridiculous results, it is best to have the three earths about ten or fifteen feet apart.

There are two methods in common use for measuring the resistance of an earth or ground, namely the ammeter-voltmeter method and the oscillating-current bridge method. When using the ammeter-voltmeter method alternating current should be used where possible, because it eliminates the effect of electrolysis and counter-electromotive forces. In those cases where direct current only is available the chance of error due to polarization may be largely reduced by using a higher voltage than would otherwise have been employed. At 110 volts and about 25 to 50 amperes satisfactory results can generally be obtained, whether the current be alternating or direct. A rheostat should be installed in circuit because it saves the ammeter from damage in case the earth is of lower resistance than estimated, or should an accident occur. The resistance of the rheostat should, of course, be deducted from the values obtained.

The oscillating-current Wheatstone-bridge method is generally used when no other source of current is available. It consists of the ordinary Wheatstone bridge, only a telephone receiver takes the place of the galvanometer, and a transformer or induction coil, and a buzzer or some other form of make-and-break is used in the battery circuit.

The results obtained with both methods should correspond, although they frequently do not. The bridge method is probably the more accurate of the two when the earths are close together. It is of little use, however, where currents may be induced from neighboring alternating-current circuits, and where the interconnecting wires have appreciable capacity and inductance; for such cases the ammeter-voltmeter method is indicated. One great advantage of the ammeter-voltmeter method is that it gives some indication of the stability of a ground, which the bridge method, on account of the small currents used, does not do. It is a good thing to leave the current on for some time after taking the measurements, and then take them again, as this may be instrumental in showing up trouble, or the drying up of the soil surrounding the earth or ground.—K. R., Chicago, Ill.

No. 306.—Cleaning Transformer Cooling Coils.—What is the best way to remove the deposit which has accumulated in transformer cooling coils without removing the coils?—F. A. H., Chicago, Ill.

It is rather an uncommon occurrence for the cooling coils of transformers to become clogged to any serious extent. It shows that the cooling water carries a particularly large amount of foreign matter in suspension or solution. Further, it might indicate that the operating temperature of the oil is exceptionally high, which would tend to hasten and increase the precipitation. The most obvious way of cleaning the coils would be by chemical action. And the safest way, and probably the quickest and cheapest in the end, would be to obtain a sample of the water and of the precipitate and submit them for chemical analysis, from which the proper solvent to use may be decided upon.

Knowing nothing about the water, or the deposit, nor even the material used for the coils—whether brass or iron—it is impossible to offer more than a very general mode of procedure. If chemical analysis is not feasible, the next best thing is to take some of the deposit and try the action of different solvents upon it. Ammonia, sodium chloride or vinegar might be effective, and they are comparatively harmless, so far as the coils are concerned. Hydrochloric or muriatic acid are sometimes used, but if the coils are of brass there is considerable danger of damage. Muriatic acid has been used on more than one occasion with good results, but great care must be exercised, and the operation carried out as quickly as possible. Use a liberal amount of acid, somewhat diluted. Fill the coils from bottom up, as this will eliminate water traps. After allowing the acid to stand in the coils for about five minutes, empty and flush thoroughly with water.

It is not enough to have cleaned the coils, but the repetition of a similar occurrence should be guarded against. It can be realized that the use of an acid solvent at frequent intervals may be liable to eat through the coils, allowing the water to enter the case, which would immediately result in a burnout. The cause of the trouble will show up by chemical analysis, from which the remedy will be indicated. Substitution of brass for iron coils, or vice versa, may be worth while.

If it is found that the trouble is due to dirt rather than chemical action, etc., it might be worth while to blow out the coils with compressed air at regular intervals.—K. R., Chicago, Ill.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Panama-Pacific Convention Held at San Francisco, September 16-18.

The Panama-Pacific convention of the American Institute of Electrical Engineers was held at San Francisco, Cal., September 16 to 18. Headquarters were at the St. Francis Hotel. Sessions for the reading of papers were held in the building of the Native Sons of the Golden West. The total registration at the convention was close to 350. Parallel sessions were held on Thursday morning and afternoon and on Friday morning and afternoon. Two of these sessions were joint sessions with the Institute of Radio Engineers. A report of these will be given in a later issue. One session was a joint session with the American Electrochemical Society, which was holding a convention at the same time.

On Saturday morning, a commemorative medal was presented to the Institute at the Exposition grounds by the president of the Panama-Pacific International Exposition. This was received by President J. J. Carty, of the Institute. The presentation took place in the Court of Abundance. The remainder of the day was devoted to seeing the Exposition grounds and exhibits and a demonstration of high-voltage phenomena by C. H. Thordarson, of Chicago, using a transformer of new design, which he has recently constructed.

A dinner-dance was held at the St. Francis Hotel on Thursday evening. An automobile trip was provided for the visiting ladies on Thursday morning, winding up at the Old Faithful Inn on the Exposition grounds, where luncheon was served.

The opening session of the convention was called to order at 10:15 a. m., Thursday, by President J. J. Carty, who made a few fitting remarks relative to the opening of the Panama Canal and the opportunity which the convention afforded for a meeting of electrical engineers from all parts of the country. He then called upon Honorary Vice-President Harris J. Ryan, who welcomed the members and pointed out the significance of the meeting. Secretary F. L. Hutchinson then made a brief address and announcements were made by W. W. Briggs, chairman of the Convention Committee, and by H. A. Lardner for one of the sub-committees. The convention then broke up into parallel sessions.

President Carty occupied the chair at the main session. The first paper was one by B. G. Lamme, entitled "Physical Limitations in Direct-Current Commutating Machinery." In the absence of the author, this was presented by F. D. Newbury.

Physical Limitations in Commutating Machinery.

In direct-current machines, there are a number of apparently distinct limitations, such as sparking at brushes, flashing at the commutator, burning and blackening of the commutator face, picking up of copper, etc., which, in reality, are very intimately related to each other. The principal object of the paper is to bring out such relationships and to show that all these actions are special cases of well known phenomena. The theory of commutation is considered only in its relation to the electromotive forces generated in the coils short-circuited by the brush; and the limiting electromotive forces per commutator bar and per brush are shown to be fixed principally by brush-contact resistance. The effect of the negative coefficient of the contact resistance is also referred to briefly. Flashing due to various causes is next taken up, and the relations between the maximum volts per bar and flashing conditions are indicated, both from test and general experience. Flashing due to various other causes, such as interrupting the circuit, is also considered. Burning and blackening of commutators, high mica, picking up of copper, etc., are treated in detail, and these actions are shown to be very closely related to the commutation limits derived in the earlier part of the paper. Noise, vibration, etc., are also considered as limitations in design. In approaching the ultimate design, these limitations become increasingly prominent. Flickering of voltage and winking of lights are two well known actions in direct-current practice. A simple explanation of the winking of lights (not original with the author) is given, with the results of tests on a generator with well proportioned compensating windings in the pole faces. Apparently the difficulty is a fundamental one, and is liable to occur in all types. In conclusion, a brief chapter is given on design limitations as fixed by commutator peripheral speed. This applies particularly to large-capacity high-voltage machines. An appendix is added covering a method for determining the maximum capacity of direct-current machines in terms of the short-circuit volts per commutator bar when the various constants in the machine are given certain limiting values. The results show that in large high-speed machines, the maximum capacity is considerably above present practice.

The discussion was opened by E. H. Martindale, who pointed out that hardness and abrasiveness are distinct qualities of carbon brushes. With undercut commutators, it is not necessary that brushes should be soft, but they should be non-abrasive. The contact drop of potential may either increase or decrease with temperature. He had never found a change of more than 15 per cent except in brushes previously impregnated.

H. R. Summerhayes referred to the importance of flickering in isolated plants. The smaller the plant the more noticeable this will be when any sudden load, such as an elevator motor, is thrown on the line.

Gano Dunn explained an important principle of commutation, not referred to in the paper. It consists in using one or more auxiliary brushes in juxtaposition to the main brush, but insulated from it. This will prevent sparking, but a practical difficulty has been the unequal wear of the brushes.

D. B. Rushmore emphasized the fact that problems of commutation involve mainly empirical solutions.

In closing the discussion, Mr. Newbury said the important point with regard to brushes is their current-carrying ability. This is usually greater in a graphitic brush, which is non-abrasive. Commutators are undercut so that this type of brush may be used.

A paper by E. W. Allen and Edward Taylor entitled "Automatically Controlled Substations," was then presented, in the absence of the authors, by C. W. Place.

Automatically Controlled Substations.

The paper gives a definition of an automatically controlled as distinguished from a remotely controlled substation, and also analyzes the duties of the attendant in the starting, loading, and shutting down, of appratus in hand-operated stations. It states that the changes in the conditions of the electric circuit which the attendant observes may also be utilized to operate control relays, and as reliable devices are already available to protect the machines against overload and runaway, his assistance in these matters is no longer necessary. The paper then proceeds on the assumption that converting apparatus should be automatically controlled and that the conditions which have heretofore governed both the design and location of substations can be modified to advantage in many cases. It advocates a reduction in size and an increase in the number of stations and endeavors by example to show the large saving in feeder copper which the proposed arrangement permits. Finally, a description is given of the automatically controlled substations installed on the lines of the Elgin & Belvidere Electric Railway.

Mr. Place pointed out that there might be an application for such substations in congested cities for street railways and for certain lighting districts.

A. H. Babcock saw a big field for them on long interurban railways. He considered it a big step in advance to secure automatic control of machines of such size.

R. F. Schuchardt said that such methods might be applicable to lighting systems, but not so readily as to railways, since the conditions are more complex; voltage must be held more steady and various regulating devices are used. This complexity and the cost of maintenance may outweigh the saving in attendance. Where space is expensive, large units must be used, and here the advantages would not be so great. Nevertheless, he expects the Commonwealth Edison Company to try out such an installation in Chicago.

H. R. Summerhayes said there was a wide difference in the requirements for such stations as to time of operation, demand, etc. It is often preferred to have control wires from a central station. It may be desirable to apply semi-automatic principles to large machines, even where there are attendants. He did not agree with the authors that the natural outcome of this development would be an increase in the number of substations.

Marine and Lighting Session.

This session was held on Thursday morning, with Harris J. Ryan in the chair. A paper by H. A. Hornor entitled "Standard Marine Electrical Installation," was, in the absence of the author, presented by John H. Finney.

Marine Electrical Installations.

The requirements of merchant and naval installations are cited in brief. The rules of the classification societies are reviewed and present practice is fully discussed. Then follow specific applications to a number of different types of ships including both merchant and naval vessels. The reasons for the application of electric propulsion to a battleship are briefly given.

The discussion was opened by S. H. Blake, who contrasted present conditions with those a dozen years back when electrical apparatus on battleships frequently got out of order and much trouble was experienced with lamp breakages. The usual voltage then was 80 volts, whereas now it is 120.

John H. Finney emphasized the important part that electricity is playing in modern battleships, which contain power plants corresponding to a good sized central station.

A paper by R. C. Lanphier entitled "Recent Improvements in Electric Lighting of Steam Railroad Cars," was then presented by A. J. Anderson.

Electric Lighting of Railroad Cars.

This paper deals with the axle-generator system of electric lighting for steam railroad cars, and describes recent improvements in control systems for obtaining proper voltage from the generator under all conditions and proper regulation of battery charge to conserve the life of the storage battery. Methods of control depending upon voltage of the battery have not been wholly successful. Since the beginning of 1914 extensive use has been made of systems of control of the battery charge based upon actual input and output in ampere-hours, and one such system, which has proved successful, is described. In the development of the system of control by ampere-hour meter, tests were made by means of a special graphic recording ampere-hour meter which gives a complete record of the treatment received by a storage battery with any axle-generator system. Actual records from long runs are reproduced, to show the results obtained in the operation of the system of control of charging by ampere-hour meter. With this system the battery has minimum work to do, in most cases operating between points of 75 or 80 per cent of full load and full charge, and the lighting load is put on the generator as much as possible.

This paper was discussed by George R. Murphy, who said that the method described by the author had been satisfactory in electric-vehicle service and other situations involving daily cycles of battery charge and discharge. But train-lighting service is of a different character; there is no uniformity in the work, which may be light one day and heavy the next. Battery control by the ampere-hour meter is based upon giving the battery a predetermined percentage of overcharge. This method is not theorectically correct and in practice is approximately so only under certain conditions. Overcharge is required (1) because all of the current does not produce the desired chemical change, as is evidenced by gassing, which varies as the charge progresses and with the rate, temperature, age of plates, etc.; (2) because of local chemical action, which also varies with conditions, but is principally a function of time. The constant-voltage system of control was introduced to meet these conditions and the operating results are nearly ideal, the control being automatic. The battery requires no charging, but what it receives in regular service and is at no time charged excessively. It is probable that as the conditions secured by control by the ampere-hour meter approximate a constant voltage across battery terminals, the results become more nearly ideal. Mr. Murphy then gave a description of a generator of the Rosenberg type, which gives constant voltage for different speeds, and illustrated it with lantern slides.

Session on Valuation of Public Utilities.

On Thursday afternoon the main session was a symposium on inventories and appraisals of electric utility properties. Three papers on this subject were presented. The first by C. L. Cory, the second by W. G. Vincent, Jr., and the third by William J. Norton.

Professor Cory also presented supplementary papers by Philander Betts on "Overhead Charges," by C. W. Wilder on "Rules for Collecting, Computing and Compiling Data in Connection with Appraisals", also one by Hermann Spoehrer on "The Value to Operating Companies of Well Planned and Executed Inventories," and one by Henry Floy on "Working Capital."

Inventories and Appraisals of Properties.

Professor Cory's paper deals with the chief factors that must be taken into account in making an inventory and appraisal of an electric lighting and power property. The paper points out the factors that are usually or practically universally recognized, the factors that are quite generally recognized, and the factors regarding which there is still serious controversy. The paper concludes by a discussion of the differences in inventories and appraisals when these are to be used for different purposes.

Mr. Vincent's paper discusses the procedure that is necessary to obtain reliable inventories and reasonable appraisals of properties that can be defended both from the standpoint of the public and the companies. The paper continues with a discussion of the extent to which detailed inventories and appraisals should be kept up to date by companies, and makes some suggestions on the best way in which detailed inventories and appraisals may be kept up to date.

Mr. Norton's paper deals with working capital, pointing out that the common method of determining this by examination of current assets and liabilities is erroneous. The method first publicly pointed out by Messrs. Palmer, King and Willard is then discussed. Most rate-making cases require a valuation by the reproduction-new method. To this value must be added the working capital in order to obtain the complete valuation of the plant, because with the plant reproduced and ready to operate a considerable amount of working capital is necessary to provide service before any revenue from operation is received. The main items in the working capital are based upon the customers' individual responsibilities for the cash investment required by utility; these three items are: (1) Service received by the customers in advance of payment therefor. (2) Demand of the customers for merchandise and supplies and receipt of same before payment. (3) Demand of customers for uninterrupted service, which requires reserve supply of fuel. To these items is added another of a general character, which is the general cash balance required by the utility irrespective of the customers' direct responsibility. The paper discusses these four items in detail, and shows how the total working capacity can be accurately ascertained.

Overhead Charges.

It is customary in valuations to add a certain percentage, ranging from 10 to 30, to the physical cost to cover such items as engineering, interest and taxes during construction, etc. Regulating bodies have shown a tendency to fix a minimum figure, while corporations sometimes make extravagant claims for such allowances. The author analysed the different elements of a utility property with regard to figures actually found in practice and arrived at the following: land, 20 per cent; buildings and similar works, 35 per cent; general equipment, 5 per cent; plant machinery, 31 per cent; transmission mains, 23 per cent; distribution mains, 10 per cent; services, 5 per cent; tools and appliances, 5 per cent; laboratory equipment, 5 per cent. In the case of one large gas company these averaged up to 17 per cent. A list of allowances is given for a large number of cases. In conclusion the author states that justice to both company and customer requires a reasonable allowance for overhead charges, which should be determined by careful analysis.

Rules for Collecting, Computing and Compiling Data.

A complete system for recording and compiling data, making computations

and preparing summaries should be adopted in any inventory and appraisal of a large utility property. The author has evolved a method as a result of a number of appraisals of properties ranging from $1,000,000 to $25,000,000. Only four standard forms are used, samples of which were shown. Information is classified as "field information" and "office information"; the latter including all results of computation and compilation. All work of the latter kind is checked by a second person, who is equally responsible for same. Twenty-five rules are given by the author covering the details of the work.

Values to Operating Companies of Well Planned and Executed Inventories.

The author gives eight reasons why inventories are of value. (1) In rate cases the rate is dependent upon the investment, which can only be fixed by an accurate knowledge of the physical property. Inventories taken only when necessity demands are more expensive and less accurate than a running inventory. (2) Numerous occasions arise where detailed knowledge of physical property is of great advantage. The need for detailed information is never realized until it is found unavailable. It is of assistance in disposing of securities to have an inventory available for inspection. Small properties frequently change hands and an inventory may facilitate a prompt sale. (3) Construction estimates are facilitated. (4) Extensions and replacements are planned more accurately and in planning, unit costs are an invaluable assistance. (5) The valuation shown on the property account of the company cannot be depended upon unless based upon an inventory. (6) The proper amount of depreciation reserve can be more readily determined. (7) Agitations for municipal ownership require a preparedness to refute fallacious statements. (8) In submitting bids for city lighting, the cost of service must usually be developed.

Working Capital.

This term is usually taken to include that part of the capital represented by cash on hand and material in stock. This limited use of the term does not properly cover everything which should be recognized in making a fair allowance, such as accounts receivable and payable. Assets and liabilities are divided as follows: Assets: cash, stores and supplies, manufactured products on hand, manufactured products delivered to customers but not billed, accounts receivable, prepayments of insurance, taxes, etc. Liabilities: accounts payable, interest accrued, wages accrued, taxes and insurance accrued. For most economical operation credit and cash must be available. The value of products delivered but not billed has frequently been overlooked or ignored since the books do not show it. Holding companies frequently control utilities. It is common practice to turn revenues over to the holding company monthly and the bills are paid by it, the subsidiary corporation merely keeping small amounts of cash on hand to pay local current bills. In this case the holding company requires the bulk of the working capital and the cash on hand by the utility does not indicate the actual working capital required. The combined assets of both companies really constitute the working capital. The amount of working capital varies with the character of the business. On street railways, the fare is paid in advance and hence less capital is required. The allowance for working capital is sometimes based upon annual gross revenue and amounts to 5 to 25 per cent. The actual cash balances of a large number of utilities average 12.5 per cent. A second method is to allow a percentage of the operating expenses, usually sufficient to cover two months. A third basis is a percentage of the appraised value, varying from 3 to 7 per cent. Tables are given showing typical allowances in actual court and commission cases.

In opening the discussion, which was participated in by many speakers, President Carty said that engineers whose minds are trained to deal with problems of the utmost perplexity are peculiarly well fitted to deal with the subjects under discussion.

J. T. Ryan said that the principal matters of disagreement arose from the difficulty of properly applying an undisputed principle. This is illustrated by four valuations in a recent condemnation suit, which varied through a range in the ratio of 4 to 9. Points of issue rarely arise over inventories. He then gave a few instances to illustrate the difficulty of application of the various suggested theories in actual cases. A valuation should be a measure of the utility's capacity to serve. Its object should be the determination of the basis for compensation for the service rendered, with justice to both sides. All other purposes are relatively unimportant. The cost of labor and material involved in building the property, or that would replace it, are not a measure of its value. An injudicious investment, if made in good faith, should be afforded every opportunity to work its way out to stability, but when this cannot be done there must be a readjustment. Intelligent expenditure of money should result in values in excess of cost. If the maximum return is limited by the actual investment, managerial ability and capital cannot be attracted to an industry. To follow any theory of original cost or reproduction cost rigidly to its logical end often results in conclusions absurdly high or low.

F. E. Hoar pointed out the great confusion of the terms, cost and valuation. Present-day prices should only be applied to a substitute plant or one which would reproduce the service at the present time. If the property is to be reproduced on the historical method it is necessary to use historical prices. There is no difference of opinion as to the equity of the problem that a company investing its money reasonably and honestly is entitled to a fair return; an estimate of the cost to reproduce should be based upon the time and the manner in which it was actually produced, using the prices which obtain at that time. This assumes that a utility is entitled to earn interest on each dollar invested.

J. B. Fisken said that working capital to take care of a jobbing business should not be considered in a valuation as it is a non-operative part of the business and should make what profit it can on the jobbing business. Similarly all non-operating property should be eliminated. He considered the value of the service an important item. In place of a valuation it should be sufficient to establish whether or not a company has watered its stock; if the investment has been carefully made, that should be sufficient.

John H. Finney said that an eight-per-cent return on invested capital is not sufficient to encourage hydroelectric development.

David B. Rushmore said the time was coming when manufacturing companies will have the same regulation as public utilities have now. The first thing to do in such work is to decide on general principles which are fundamental, and then it should be a simple matter to apply them.

L. B. Ready raised the point that bond discount should not be included as capital in a valuation, but should be considered in fixing the rate of return.

Professor Cory then closed the discussion. He claimed that the bond discount was an actual outlay of the utility and formed a part of the cost and hence should be included in the capitalization. He said that the entire public is interested in having the best possible service supplied at the least possible cost not only in the present but in the future, and no restriction should be put by official bodies in attaining this end.

Electrophysics Session.

Vice-president J. F. Stevens occupied the chair at the Electrophysics Session which was held in the afternoon. The first paper to be presented was one by F. W. Peek, Jr., entitled "The Effects of Transient Voltages on Dielectrics."

Effect of Transient Voltages on Dielectrics.

In practice, failures of dielectrics are generally caused by transient voltages. It is, therefore, of great practical importance to determine the various phenomena affecting the strength of dielectrics and means of protecting them when they are subjected to known transient voltages. An impulse generator from which impulse voltages of any given wave front, length of tail, etc., can be obtained, is described. Energy is required to rupture gaseous, liquid and solid dielectrics; this introduces a time element. On account of this time lag, when voltage is applied at a very rapid rate, as by an impulse, spark-over does not occur when the continuously applied break-down voltage is reached. The voltage rises above this value during the time rupture is taking place. This rise in voltage above the continuously applied break-down value is greater, the greater the rate of application. The time depends upon the nature of the dielectric, the dielectric field, the shape and spacing of the electrodes, initial ionization, etc. The strength of air between spheres and needles for impulses of

different front, length of tail, etc., is given, as well as the time in micro-seconds and the voltage required to rupture air between spheres and needles on the front of waves rising at various rates. Transient spark-over and corona voltages for wires, surface spark-over, insulator spark-over, effects of polarity, air density, practical application, etc., are given. Transient spark-over voltage and time are recorded for oil and various solid dielectrics. The general laws of breakdown of dielectrics by transient voltages are summarized.

The discussion was opened by J. C. Clark, who described an experiment recently performed by Professor Ryan in which a circuit containing a condenser and a helix was placed in juxtaposition to another coil; an air gap was placed in parallel with the helix. The circuit could be tuned to resonance. A discharge across the spark gap was dependent upon the rapidity with which the point of resonance was passed when tuning.

E. E. F. Creighton said that this paper explained why lightning discharges sometimes pass by an air gap and injure apparatus intended to be protected by the air gap. The vacuum lightning arrester shows the same effect, the time required for a discharge depending upon the voltage applied. A high frequency can sometimes be applied to an insulator containing a crack, without puncturing it, when a low frequency would be sure to puncture.

F. F. Brand said that the paper also explained why time and energy are required for flashover when an insulator has corrugated surfaces. The time lag is longer at low air densities. At high altitudes, consequently, flashover does not occur so readily.

P. H. Thomas, R. W. Sorenson and J. M. Weed also joined in the discussion, which was then closed by Mr. Peek. The latter stated that with transient voltages insulators flash over at about the same voltage, whether wet or dry.

A paper by A. G. Collis entitled "Arc Phenomena," was then presented, in the absence of the author, by W. D. Peaslee.

Arc Phenomena.

Increasing developments in electric transmission systems impose correspondingly increased duties upon switchgear, and therefore a study of the arc phenomena accompanying the rupture of circuits in oil switches becomes of growing importance. The paper describes a number of experiments made to determine the influence of differently shaped arcing contacts upon the disturbances following rupture of an alternating-current circuit, and various theoretical considerations are discussed with a view to modifying the design of oil switches so as to increase their rupturing capacity and thereby eliminate auxiliary devices with their added complications and expense. The use of reactors is also considered in connection with the rating of oil switches.

E. B. Merriam, in a written discussion, gave the results of tests upon oil switches up to 9,000 volts and 25,000 amperes. These were illustrated with lantern slides. The shape of the contact has little influence upon the action. The dielectric medium affects the shape of the arc, oil, water and carbon tetrachloride giving different results. The position of the side walls also affects it. Pressures of 5,000 or 6,000 pounds have been observed near the arc, whereas near the walls of the inclosure it is more nearly 500 pounds. The bottom, as well as the sides of the inclosure, are distended by the explosion, indicating that the pressure is the same in all directions. Rectangular vessels are usually used. Different effects are observed in different switches on account of a difference in the reinforcing. The author does not give any evidence in favor of a multiplicity of breaks, which he advocates. In considering time of operation, a distinction should be made between the time for the mechanical beginning of the break, and the time of the elctrical operation or completion of the rupture. If the electrical time is not more than one-half cycle, there will be no serious abnormal voltages.

Chester Lichtenberg also presented written discussion in which he disagreed with the author. He presented oscillograph records for direct-current magnetic blowouts, in which there was an interval of but 0.2 second between the maximum current and break. For oil switches, there is a sudden rupture, with high-voltage rise.

Ford W. Harris also presented written discussion taking issue with the author upon a number of points. The results given do not agree with those obtained by him. He described a number of his own results and the conclusions drawn from them.

In closing the discussion, Mr. Peaslee thought the differences brought out were due to the point of view and the conditions of experiment.

The last paper to be presented at this session was one by A. E. Kennelly, F. A. Laws and T. H. Pierce, entitled "Experimental Researches on Skin Effect in Conductors." In the absence of the authors this was presented by C. L. Cory.

Skin Effect in Conductors.

The results are given of about one hundred series of tests, each covering a range in frequency up to about 5,000 cycles per second, on the impedance of long loops of parallel conductors of different metals, sizes, and cross-sectional forms. The measuring apparatus is detailed. The theory of the skin effect in solid rods and in indefinitely wide flat strips is appended in a new and simplified form. The experimental results agree with those computed on theoretical grounds. At high frequencies the proximity of the two wires of a circuit has a marked effect. Stranding has slight effect. Tubes have the least skin effect. The theory, involving Bessel functions, is given in an appendix.

This paper was discussed by C. L. Cory, H. B. Dwight and L. P. Ferris, and the session then adjourned.

Telephony and Telegraphy Session

The main session on Friday morning was devoted to papers on telephony and telegraphy, with President Carty as chairman. The first paper, by Bela Gati, entitled "Submarine Cable Rapid Telegraphy: Ocean and Intercontinental Telephony," was in absence of the author presented by D. I. Cone.

Rapid Cable Telegraphy and Intercontinental Telephony.

The speed of the cable telegraph is not satisfactory; slow work makes cabling very expensive. The direct-current impulses are lengthened on a long cable, because the long cable vibrates with its own natural frequency, which is very low. The impulses of the direct current overflow over a certain limit. Alternating currents do not suffer such overflowing. The oldest form of the alternating-current application is the inverse current. Especially Picard and Gott attained good results with their inverse-current systems. Another direction for increasing the speed of cabling is worked out by various cable-relays; Gulstad's, Muirhead's, Heurtley's and S. G. Brown's relays are discussed. Their use has not doubled the speed. The attempts with the high-frequency system on ordinary cables are discussed. The theory of the resistance of the cable is given, and different cables are taken into the computation. The cable rapid telegraphy is solved by the inductive shunts with little resistance. The problem is nearly the same also for ocean telephony; the difference is, that for common telephony various frequencies must be transmitted without distortion. The ocean telephony with aid of high-frequency currents on improved cables is already a solved possibility. For connecting continental circuits, strong-current microphones, more sensitive receivers, improved single-wire loaded circuits and telephone relays can be applied, which remove every limit of ocean and transcontinental telephony.

There was no discussion on this paper. The next paper was entitled "Automatic Switchboard Telephone System of Los Angeles," by W. Lee Campbell.

Automatic Telephone System of Los Angeles.

This paper narrates some of the history and describes the present automatic switchboard telephone system in Los Angeles. It describes how the system, which began to give service with one manual switchboard in 1902, has gradually been extended and transformed through several interesting stages of combined automatic and manual operation, until it now comprises 15 automatic offices and a traffic distributor switchboard which serves a total of 60,000 subscribers' stations—the largest automatic switchboard system in the world. The layout of central offices in the present plant is shown in contrast with the layout of offices in the Bell telephone plant of approxi-

mately the same size, operating in the same city. The traffic distributor switchboard used for handling the outgoing calls from a large number of private-branch-exchange switchboards is the largest board of the kind in operation, includes thirty operators' positions, and handles a heavy traffic. A general explanation is given of the equipment of the board, methods used in operating it and of the economies realized by means of it. Specially interesting and important features in handling the telephone business of a large metropolitan area like Los Angeles are the methods used in caring for calls for time and for information concerning subscribers' numbers, addresses, etc., and for answering subscribers' complaints and calls for long-distance connections. All of these methods are discussed at some length. The paper closes with a concise statement of the practice of using standards of adjustment and performance for securing uniformly good service from the automatic apparatus scattered over this area of about two hundred square miles and handling from 500,000 to 600,000 calls a day.

Written discussion of this paper was submitted by Leo Keller, Fred L. Baer and John Wicks. Mr. Keller described the process of cutting over subscribers from the manual to the automatic system without changing numbers. Mr. Baer pointed out that depreciation of automatic equipment is small, due to either wear or obsolescence. He also described the operation of a combined manual and automatic system. Mr. Wicks pointed out that when subscribers had the option of calling by the automatic dial or through an operator, ninety per cent prefer the former, thus proving its efficiency.

Then followed a discussion on inductive inteference, which was introduced by a report giving the progress of investigation being made by the California Joint Committee on Inductive Interference. This report outlined the work which has been accomplished by the committee during the past year. Experiments have been made upon a 37-mile power circuit and private telephone circuit at San Fernando. The chief points investigated were the unbalances to ground of a power circuit isolated from ground; the relationship of triple-harmonic residuals to the magnetic density in grounded star-connected transformers; the magnitude of triple-harmonic residuals as affected by transformer connections; and the induction between power and telephone circuits. Tests on unbalances were made without transposition, with two transpositions or one barrel, and with five transpositions or two barrels. At 50 cycles, one barrel was as effective as two. At high frequencies two barrels were more effective and the non-transposed line gave better balance than at low frequency. Tests of induction at low frequency were made with balanced voltages, balanced currents, residual voltages, and residual currents. Induction at high frequencies was measured with a single-phase source of energy. Computed and measured inductances were found in close agreement. The effect of the ground on one phase of a normally isolated system was studied both experimentally and theoretically. In addition to the San Fernando work, a study of residuals under operating conditions was made on grounded-neutral networks.

Much work has been done by telephone companies at the request of the committee. The American Telephone & Telegraph Company has undertaken the redesign of its standard telephone transposition system. The Pacific Telephone & Telegraph Company has submitted a report on the development of balance of telephone circuits.

The future work of the committee was outlined, and will continue along the lines previously announced. The problem offered by parallelism between power and communication circuits involves line configuration and co-ordinated transposition systems, and also the control of residuals and their restriction to frequencies and magnitudes which do not cause material interference. As to the former, the problem is identical for both isolated and grounded-neutral types of power systems. The latter differs entirely in the two types. It is proposed to investigate one parallel involving the isolated type of power system and several parallels involving the grounded-neutral type. It is proposed also to study the effect of circuit configuration on the induction between power and communication circuits. Upon the completion of the work, the committee expects to draft a supplementary report to the Railroad Commission, giving its conclusions and such recommendations as it feels necessary to make the rules recommended in its former report more complete and explicit.

August J. Bowie, Jr., of San Francisco, referred to experiments by George W. Linke which appeared in the *Elektrotechnische Zeitschrift* in 1914. The result of the experiments described was that the oil switch caused the most serious harmonics, that the air switch without horns was gentler in its action, and that the air switch with horns was ideal in its action in suppressing the harmonics and gradually reducing the current before the opening of final break. The speaker said that it was supposed that the arcs which occurred in air caused destructive rises of voltage on short-circuits. This had been disproved by recent experiments, which showed definitely that the rise of voltage which occurred from opening a horn type of switch was less than in the case of an oil switch.

J. B. Fisken said that some of the rules were a little hard on the power companies, possibly arising through a misunderstanding. Such a rule was that with reference to parallelism—the rules provided that every reasonable effort should be made to avoid parallelism—the power companies try to carry that instruction out, but are not told what parallelism is. He requested information as to what a parallelism is. As to the question of air-break switches versus oil-break switches, he had had occasion to use air-break switches. High frequencies were not present to as great an extent with the air-break switch as with the oil switch. He thought the committee should make some investigation as to the effect of killing the charging current on a tower line. The reason for the request was that something like ten years ago they built two lines for 60,000 volts, 60 cycles, that paralleled main telephone lines. They were operated for many years without trouble. What is technically known as "bats" had recently put in an appearance and it puzzled them to know where they had come from. The methods of operation had not been changed in the slightest. They found in taking the load off the line there was no result, but when they came to break the charging current, there was a result. The connection between that line and the tower line was this: Several years ago in order to get rid of the burning of the pole tops they grounded the pins on both of these lines. It had occurred to him that possibly the ill effects they got on the line were due to the discharging of these condensers, and possibly the rush to ground through the ground wires might have caused the trouble. They had avoided the trouble by doing the switching on the low-tension side, but that in many cases is not a practicable proposition.

J. E. Woodbridge stated they had some trouble with "bats" and had found the trouble to be due to the fact that the three individual single-pole oil switches in the three phases of the 100,000-volt line did not open at exactly the same instant. These switches were not mechanically connected to open as closely as possible at the same instant, and it was partially on account of that difficulty that the ruling was made for mechanical interconnection between the phases. That slight difference in the time of operation of the three phases is a small measure of what is to be found in the operation of air-break switches.

J. P. Jollyman pointed out that the things which cause the most trouble with the parallel circuits are not essential to the operation of the power circuits. It is the things that creep into the power circuits and have nothing to do with the actual business of transmitting power that cause most of the trouble with the parallel communication circuits. The power companies

should do what they can to eliminate these. The desirable frequency for the transmission of power represents a frequency very materially below the average frequency of voice currents. Certain harmonics are introduced into the power system which are of no importance to the power line, and serve no useful purpose. The reduction of the harmonics and switching effects is, with respect to the telephone lines, the principal problem before the committee.

E. E. F. Creighton said that oscillograms show that the operation of both oil and air-break switches depends upon conditions, and they cannot be compared without knowing the conditions. If there is capacitance in the line, the break under oil is sharper. But if transformers are left connected to balance the capacitance the break takes a different character. A sharp break causes oscillations. The oil switch opens a loaded line very quietly. He then discussed the transients arising from lightning. If these cause a single-phase ground, the case is hopeless. Amelioration depends upon obtaining insulators which will flash over rather than puncture, and extinguish the flash as quickly as possible. Even then there will be a surge on the telephone line, requiring a vacuum type of lightning arrester to limit the induced current and reduce the noise.

P. M. Downing, a member of the committee, said that the original report was not entirely satisfactory to either the power or telephone interests, but was a compromise. In the final report it was hoped to clear up some of the indefinite points, such as the definition of parallelism. It is not true, as sometimes stated, that the telephone company has power to decide what is a parallel.

A. H. Griswold and J. E. Woodbridge also joined in the discussion, which was then closed by A. H. Babcock.

Mining Session.

A parallel session was devoted to papers dealing mainly with mine work. This session was presided over by Vice-president Harris J. Ryan. The first paper was one by Charles Lagrand entitled "Diesel Engines for Generator Drive." In the absence of the author, this was presented by W. D. Peaslee.

This paper described some investigations made in Europe of Diesel engines of large capacity with a view to their suitability for driving generators under conditions prevailing in mining camps in Arizona. The advantages of the four-cycle engine are known maintenance and repair cost, smaller fuel consumption and greater simplicity. The advantages of the two-cycle engine are less lubricating cost, steadier running, less liability of trouble from sulphur in fuel oil, greater output per cylinder, and less cost per horsepower. Two of the latter, rated at 1,250 horsepower, were installed, direct-connected to three-phase generators; the latter operated in parallel without difficulty. California crude oil was used as fuel.

The paper was discussed by Wilfred Sykes, E. W. Belden, J. C. Clark, W. D. Peaslee, A. H. Babcock, M. H. Gerry, Jr., William H. Rost, G. N. Eaton, H. S. Jones, T. R. Landsborough and R. Tschentscher.

Mr. Sykes pointed out that Diesel engines require more attention in operation than other types of prime mover and attendants must be more highly paid. As the size of cylinders is increased, difficulties in manufacture and operation also increase. Mr. Belden stated that the plant described by the author had operated satisfactorily, as was indicated by the ordering of a duplicate. Mr. Peaslee thought the cost of maintenance after the first two years would probably be high. Mr. Babcock told of the excellent results in using oil engines, but said that the fixed charges on the high initial cost were sufficient to counterbalance the economy in fuel. Mr. Gerry thought the high cost would diminish with time. Mr. Rost said it was easy to get men to operate Diesel engines and little trouble was had in existing plants. Mr. Jones pointed out that the author of the paper had had experience in running this type of engine since 1908 in Arizona and still favored it. Mr. Tschentscher said the best operators are those who have not had any experience with steam engines.

A paper by Wilfred Sykes entitled "A Large Electric Hoist" was then presented, in the absence of the author, by G. B. Rosenblatt.

The paper described an electric hoist recently installed in a mine at Butte, Mont., having a depth of shaft of 4,000 feet, net weight of load 14,000 pounds, weight of skip and cage, 9,000 pounds and maximum hoisting speed 3,000 feet per minute. Some results of operations were given. This hoist is of special interest as being the largest electric hoist in the United States and containing some important departures from previous practice.

Graham Bright in a written discussion pointed out that the close agreement between operation and guarantees indicated that performance of such machines can be precisely predetermined.

Selby Haar said he gathered statistics of electric hoists from all over the world and knew of 700 with a capacity over 200 horsepower. The largest hoist in the world is an electric one built in the United States and now operating in South Africa. He favored placing the flywheel on the end of the set instead of at the center, as this simplifies the design and permits uncoupling when the load is light.

F. D. Newbury, M. H. Gerry, Jr., and G. N. Eaton also joined in the discussion, which was then closed by Mr. Rosenblatt. The latter stated that flywheels placed at the end of the sets were usually of less weight and this practice is not desirable for a flywheel of 50 tons. In the present case a supplementary hoist is used at times when the load is very light, as on holidays. The first consideration in adopting the electric hoist was reliability, the second was safety, and the third was efficiency. The efficiency of an electric hoist as determined by comparing the input of energy with the tonnage lifted was 46 per cent as against 32 per cent with the previous air installation. The latter had been adopted to supplant steam at an earlier date before the owners had confidence in the electric hoist.

A paper entitled "The Modern Electric Mine Locomotive," by Graham Bright, was then presented in the absence of the author by G. N. Eaton.

Electric Mine Locomotive.

The day of the small mine with small equipment is passing, and in the future most of the bituminous coal mining will be accomplished in larger mines using heavy equipment. The demand for larger capacity in equipment has been increasing rapidly of late, and owing to the restricted space available for the equipment on a mine locomotive, difficulty is being experienced in designing equipment to meet the conditions. A possible solution of the problem is in providing forced ventilation for the motors which are of a type that require very little ventilation to produce a large increase in the continuous rating. This scheme has been tried out on a large locomotive and the results indicate that forced ventilation will play a prominent part in meeting the extreme severe conditions that are frequently arising in the mine locomotive field.

This paper was discussed by Wilfred Sykes, M. H. Gerry, Jr., and E. H. Martindale. Mr. Sykes pointed out that an air blast cannot be applied to all motors effectively, as ducts are necessary for the air to reach the hot spots. Its application is also limited by the fact that after a velocity of 2,000 feet per minute is reached, added velocity does not increase the cooling effect.

In closing the discussion, Mr. Eaton said that undercutting mica had been tried on the commutators of mine motors, but had been abandoned, as the combination of oil and coal dust led to short-circuits.

Transmission Session.

At the Transmission Session on Friday afternoon, Vice-president J. S. Stevens occupied the chair. The first paper was one by G. P. Roux, entitled "Delta-Cross Connection of Transformers." In the absence of the author, this was presented by E. E. F. Creighton.

Delta-Cross Connections of Transformers.

Two methods of transformer connections, the tee-cross and the delta-cross, are described, with their application for parallel operation of two-phase and three-phase systems. An attempt is made to explain as clearly as possible the voltage, current and phase relation, and the dephasing action which takes place in each case. The delta-cross system of connections lends itself to a great number of applications, either for

the parallel operation of two-phase and three-phase systems or for the simultaneous supply of two-phase and three-phase power from one bank of transformers. It is to be noted that in this system of connections no special taps are required, except a 50-per-cent tap on one transformer (usually easily obtainable), the compensation of one phase of the system being done externally by means of a small booster transformer. The simplicity of connections, the feature that no special transformers are required, and no special taps necessary, give the electrical engineer facilities to meet promptly and economically the requirements inherent to two-phase and three-phase simultaneous distribution from only one transformer bank.

This paper was discussed by Selby Haar, W. A. Hillebrand and L. F. Blume. Mr. Hillebrand said that the connections suggested by the author had been used by the Pacific Gas & Electric Company for ten years. With a core-type transformer, the leakage flux may be large and cause unbalancing. The author has omitted any consideration of the regulation due to leaking and lagging currents. Mr. Blume said that the delta-cross connection is not desirable for transformation from three-phase to two-phase, which has some disadvantages not mentioned by the author.

A paper by F. J. Peters entitled "Harmonics in Transformer Magnetizing Currents" was, in the absence of the author, presented by F. D. Newbury.

Harmonics in Transformer Magnetizing Currents.

The purpose of this paper is to show in a concise manner the cause and effects of higher harmonic currents in magnetizing currents of transformers. A hypothetical case is analyzed to show the cause of the harmonics; then the schemes of connecting transformers that are commonly used for polyphase transformation are taken up and the effects of the harmonics on each case pointed out. The author also shows the reason why third-harmonic voltages are not developed in the three-phase core-type transformer when connected star-star.

This paper was discussed by D. I. Cone, H. S. Osborne and L. P. Ferris. On a line with delta-star connections at one end and star-delta at the other, Mr. Cone said that the harmonics in the two banks of transformers will be opposed to each other and the only flow along the line will be a differential one. The result of this opposition is to raise the potential of the line above the ground by an amount equal to the voltage of the third harmonic. Mr. Osborne gave an analytical treatment of the problem, with figures and examples.

L. N. Robinson then presented a paper entitled "Phenomena Accompanying Transmission with Some Types of Star Transformer Connections."

Transmission With Star Transformer Connections.

The purpose of this paper is to demonstrate the phenomena attending the operation of star-star transformers with grounded neutral on the line side. Contrary to current opinions, the author believes the abnormal voltages and destructive effects, which often accompany star-star operation, are due to even harmonics, at least in a large number of cases. As high magnetic densities, the third harmonic voltage may be appreciable, but the indications are that the even harmonics will cause damage at nominal magnetic densities lower than those which require appreciable third-harmonic exciting current. The data on which the conclusions are based, include approximately 150 oscillogram waves and a correspondingly large number of meter readings. The data are omitted from the text to a large extent, because the details could not add materially to the discussion. The tests are simple and can easily be made with an oscillograph in any laboratory or substation. One precaution must be kept in mind, namely, that the observations should start at low voltages, which may be increased gradually until the various phenomena are observed. Unless this is done, the equipment may be wrecked.

This paper was discussed by Harris J. Ryan, J. C. Clark, H. O. Stevens, W. A. Hillebrand, J. B. Jollyman and F. F. Brand.

Objections were made to the author's method of presentation, as the conclusions given could not be accepted without data to support them. Some of the conclusions may be misleading by lacking generality.

Mr. Stevens described an experiment in which alternating and direct excitations were superposed upon one transformer, with the result that the exciting current had an even harmonic, as was shown by the oscillograph. A similar condition will sometimes be found in a rotary converter and in the circuit of an arc furnace.

Mr. Brand said that where an auxiliary delta winding is used to obviate the triple harmonic, it should have the same capacity as the other windings.

J. Murray Weed then presented a paper entitled "Abnormal Voltages in Transformers."

Abnormal Voltages in Transformers.

This paper deals with the electrical behavior of transformer windings when subjected to steep wave fronts and high-frequency wave trains. The dependance of the internal voltages produced, upon the distribution of capacity, with the inductance of the winding, is discussed. Practical windings are divided into two general classes, one in which inductance and capacity are practically uniformly distributed, and the other in which the capacity is more or less concentrated at certain points, with relatively concentrated portions of inductance intervening. Neglecting the effects of the high-frequency dielectric losses in the insulation at high frequency, distinct mathematical analysis is given to these two classes of winding to determine the ratios of the internal voltages to the voltage of the external wave or wave train. The resulting internal voltage distributions are plotted for various frequencies, and curves are plotted for the relations of maximum internal voltages to frequency. These curves show that some frequencies are dangerous, while others are not, but it cannot be said that one of these types of winding is better than the other from the standpoint of the possibility of excessive internal voltages. The analysis is by no means complete, but an examination is made of the facts and fundamental principles involved which will enable us to insulate for and guard against excessive internal voltages in a more scientific manner.

This paper was discussed by R. W. Sorensen, F. F. Brand and P. H. Thomas. Professor Sorensen described an experience with a 150,000-volt line transforming down to 60,000 and 15,000 volts at various points. The low-voltage secondaries were connected in a network. Trouble from steep wave fronts was experienced all over the network whenever a surge was caused at any point. To obviate this, a transformer with primary in star was connected on the 15,000-volt network and the neutral point grounded. The 60,000-volt terminals were delta-connected, but not connected to any line. Since then the trouble has been entirely of a local nature.

N. S. Diamant then presented a paper, entitled "Calculation of Short-Circuit Phenomena of Alternators."

Short-Circuit Phenomena of Alternators.

The theory and explanation of the electromagnetic phenomena involved in the sudden short-circuit of alternators, as given by Berg and Boucherot, is first briefly considered. It is shown how complex the different resistances and reactances are that enter the equations of sudden short-circuits. New methods are developed for the experimental determination of these quantities by simply determining the rise of direct current in the field and armature circuits. Also new simple methods are given, based on theoretical equations, for the calculation of short-circuits directly from oscillographic records. Data relating to the short-circuit of a 45-kilovolt-ampere alternator are given; also an electrical device, designed by the writer and used in most of the tests, for short-circuiting a machine at any given point of the electromotive force wave, is described.

This paper was discussed by F. D. Newbury and C. J. Fechheimer. The latter said that it is almost impossible to estimate the constants which determine the rate of dying down of the short-circuit current, on account of eddy currents in the solid rotor, etc. This, however, is not important, as the maximum value is what counts. To be on the safe side, the maximum possible current, with any arrangement of short-circuit, should be assumed. He corroborated the author's statement that the reaction of a star-connected alternator is the same with one phase short-circuited as with three. In order to withstand short-circuit, he favored large armature reaction, to be obtained by using deep slots in the stator. He then discussed the field distribution with the short-circuit current, and explained why the harmonics are suppressed. He disagreed with the author as to the insertion of resistance to keep down the current and the use of iron in series reactance coils.

ILLUMINATING ENGINEERING CONVENTION OPENS IN WASHINGTON.

Record Attendance and Papers of Unusual Interest Mark Ninth Annual Meeting.

What is considered the greatest impetus to industrial lighting since the advent of electricity has been given by the Illuminating Engineering Society in its "Code on Lighting Factories, Mills and other Work Places," presented at the opening session of the ninth annual convention of this organization at Washington, D. C., September 20. In all likelihood the recommendations made will be more or less criticized and amended but a foundation has been laid which will undoubtedly form the basis of standard practice in the future and greatly increase the efficiency of industrial illumination.

Of equal importance was the presidential address by Dr. A. S. McAllister, presented after a cordial address of welcome had been extended to the delegates by Conrad Syme, corporation counsel of the District of Columbia, and a suitable response made on behalf of the Society by Preston S. Millar.

Dr. McAllister selected as his text "Simplification of Illumination Calculations." So far as numerical results are concerned, he said, it is absolutely safe to ignore the direction of travel and mode of propagation of radiant energy from the source of light to the surface of which this energy is absorbed. Total energy absorbed equals the total energy produced.

When methods of calculation give results not in conformity with this relation it is safe to state that the methods are wrong either in principle or application. Thus for checking results obtained by more laborious methods the absorption of light method is highly advantageous. In many instances it is permissible to abandon the more complicated methods and rely upon the simplest and absolutely correct energy-ratio method, with merely an occasional reference to some more indirect method for determining the space distribution of the illumination where this is of importance.

"Almost all of the solutions offered for problems in illumination," said Dr. McAllister, "have been based on the tacit assumption of point sources rather than surface sources. Even when dealing with plane surface sources the authors have usually treated them as made up of an infinite number of point sources arranged in one plane, and have based their solutions on the 'inverse square' law and other relations developed from the fundamental point-source conception. In order to obtain results consistent with the known facts in this case, it has been necessary to assign to each infinitesimal point source in the plane certain physical characteristics not possessed by ideal point sources—that is, the ability to produce light in only one hemisphere which is the fundamental attribute of an infinitesimal plane surface source.

"It needs no argument to show that all calculations are immensely simplified by adopting initially the surface source conception and utilizing at once the well-known relations developed for surface sources.

"Instead of determining the illumination produced by the source on a chosen plane by reference to the 'inverse square' law and the integrated 'candlepower,' the identical value can be derived more conveniently by means of the fundamental ratio existing between the 'apparent luminous density' of the source and the lumen density on the surface illuminated, which ratio depends solely upon the solid angle subtended by the source when viewed from the chosen plane.

"When dealing with the surface sources it is necessary to take into consideration the fact that not all surfaces obey the so-called 'cosine law' of emission in accordance with which a surface would appear uniformly bright when viewed from all possible locations. However, it is equally necessary to take into consideration the fact that the candlepower from a so-called point source or the 'apparent candlepower per unit area' from a surface source is not uniform in all directions in space. The fact of the matter is that all practical sources emit light in such a way as to appear non-uniform in brightness over the surface when viewed from any one locality, and any one point on the surface apparently varies in brightness when viewed from different locations in space. It is impossible so to express the brightness that its value will not be subjected to the changes here referred to.

"If the surface were ideally perfect in its emission, its brightness would be everywhere equal and uniform, and its apparent candlepower would vary with the cosine of the angle of deviation of the surface from normal to the line of vision; that is, the surface would obey Lambert's 'cosine law of emission.' A surface which is not ideally perfect in emission can be compared directly with one following the cosine law of emission irrespective of the units in which the outputs or appearances are expressed.

"For convenience in calculation and purpose of comparison, it is advantageous to express the outputs in terms of the lumens, and the output density in terms of the lumens per unit area. It is equally as convenient and logical to express the appearance in terms of the luminous output density, selecting for the unit the appearance of a surface emitting in accordance with Lambert's cosine law. For this unit of appearance there has happily been suggested the term 'lambert,' which is applied to the appearance of a surface emitting one lumen per square centimeter in accordance with Lambert's cosine law of distribution; it is equivalent in appearance to that of a perfect matt surface of 100 per cent reflecting power illuminated with a density of one lumen per square centimeter.

"Problems relating to both the output and the appearance of practical lighting sources are greatly simplified when use is made of the real surface-source conception rather than the fictitious point source conception."

A committee was appointed, composed of Messrs. Sharp, Millar, Ives and Hyde to consider the points brought out by the president and report at a later session.

L. B. Marks presented the "Code on Lighting Factories, Mills and Other Work Places." This comprises, in effect, complete specifications for the lighting of industrial establishments based upon accepted practice. The requirements of various classes of work are set forth and recommendations made as to the most suitable types of installation. The code also takes natural lighting into consideration and makes recommendations as to sizes and locations of windows, skylights, etc.

The report of the Committee on Progress was presented by F. E. Cady. This report views the features of lighting progress during the past year, for the most part being a summary of published matter. The report points out that there have occurred during the year two events of striking significance which have affected illuminating engineering. The European War has afforded grim and hitherto undreamt of possibilities in the use of light, while on the other hand, the Panama-Pacific International Exposition at San Francisco stands as a magnificent example of the art of applied illumination.

Dr. E. B. Rosa presented the report of the Committee on Research. This Committee during the past year has, under the auspices of the Bureau of Standards of Washington, been engaged in research work looking to the determination of accurate comparisons of light of different color values. Dr. Rosa pointed out that the measurements of quality of brightness for different colors has previously been accepted as a common basis for comparison. Flicker photometers have been satisfactory also except that differences in readings are obtained by different groups of observers depending upon

their eye sensitiveness to various colors. The work done by the Committee represented over 60,000 different settings of a flicker photometer and 114 inexperienced observers were employed to make the measurements. The results indicated that the latter instrument affords a means of precise comparisons between light of different colors. Care, however, must be taken in the selection of observers. Dr. Rosa said that where color differences are not too great the equality of brightness measurements give reliable results.

The report was discussed briefly by E. C. Crittenden, of Washington, Dr. H. E. Ives, Philadelphia, and Dr. E. P. Hyde, Cleveland. Mr. Crittenden elaborated somewhat upon the methods of conducting the research works, stating that the principal idea was to obtain average results from a large number of observers.

Dr. Hyde questioned the advisability of using the contrast photometer for measuring equality of brightness, as measurements are more easily made using the contrast principle.

Dr. Ives complimented the Association on the work done by this Committee and urged its continuance.

At the session on Monday afternoon Dr. C. H. Sharp presented the report of the Committee on Nomenclature and Standards. This report contains new terms for illuminating engineering practice, definitions, and a list of photometric units with their abbreviations. The most important new term is the Lambert, the C. G. S. unit of brightness, defined as the brightness of a perfectly diffusing surface radiating or reflecting one lumen per square centimeter. This is equivalent to the brightness of a perfectly diffusing surface having a coefficient of reflection equal to unity and illuminated by one phot.

J. R. Cravath, of Chicago, opened the discussion urging that illuminating engineers use the term Lambert wherever possible, as it was originated by the Society.

Mr. Pierce of the Welsbach Company questioned the advisability of stating the specific output of illuminants depending upon combustion in lumens per British thermal unit per hour. The output of light is independent of the calorific value of gas.

A paper entitled "Illumination Efficiencies as Obtained in an Experimental Room," by Ward Harrison and Earl A. Anderson was presented by the former. This paper describes a series of illumination tests performed in a portable room designed for this purpose. The room dimensions and the arrangements of outlets were varied to approximate the diverse conditions met in practice. Wall, ceiling and floor combinations of white, black and intermediate colors were tested with units of three general types of light distribution. The authors state that using the data in this paper as a basis additional tests with other reflectors are planned to obtain a more complete comparison of the efficiencies of the various types of lighting equipment now in common use.

In the discussion J. R. Cravath of Chicago emphasized the marked effect of wall absorption on efficiency. Regardless of efficiency the lighter the walls the better the conditions from the standpoint of high comfort.

The paper on "Semi-Direct Office Lighting in the Chicago Edison Building," was presented by William A. Durgin. The equipment of a typical office test room and comparative tests on five lighting systems to show relative eye fatigue, glare, shadows, uniformity of intensity on desk plane, utilization efficiency and effective flux color, are described. The test results, leading to the development of a particular semi-direct unit for lighting the offices of the Commonwealth Edison Company, are discussed and the details of the adopted fixture structure and glass bowl characteristics presented. Data are given on the illumination effectiveness, arrangement, appearance, and dust factor of the completed installation, special emphasis being placed upon the importance of the use of higher intensities and filtered flux.

F. A. Vaughn of Milwaukee opened the discussion on this paper. He thought that the fixtures used in this building mark a step in advance and should stimulate manufacturers to produce a greater variety and a greater density in glassware for semi-indirect use.

J. R. Cravath, of Chicago, stated that in designing the lighting for the Edison Building sharp contrasts had been eliminated in order to avoid glare.

Mr. Pierce, of New York, said that there is a difference in a company designing glassware for its own use and a manufacturer designing glassware that must necessarily be approved by the public. He thought the greatest obstacle to raising the standard of illuminating glassware is that the public demands a higher degree of brightness than necessary.

A. L. Burroughs, of Newark, thought that from the standpoint of the central station greater density glassware was desirable because it has the additional feature of increasing wattage consumption for a given area.

H. T. Owens, of New York, held that the industry is unconsciously reverting back to direct lighting because of the present tendency to adopt small units.

C. L. Law, of the New York Edison company, at this point, presented some data on the use of nitrogen-filled lamps during the past year by his company. Of all type C lamps sold during the year covered by the data 55 per cent were of the 200-watt size. The 100-watt size ranked first in popularity. It was shown that 33 per cent of all lamps sold from August, 1914, to July, 1915, were disposed of during the month of March, this, however, being due to a special campaign carried on during the month. It was shown further that 93 per cent of all lamps sold were for interior use and of the remaining 7 per cent fully 7/8 were of the 750-watt size. As to burnouts 23 per cent occurred among 1,000-watt lamps and 14.49 per cent of the 750-watt size. The distribution of sales was given as follows: 39 per cent to stores; 12 per cent to offices; 9 per cent for exterior lighting; 7.5 per cent for show window lighting; 3.5 per cent auditorium; 1.5 per cent for churches; 0.5 per cent for schools.

Two sessions were held on Tuesday, one in the morning and a street lighting session at night. A reception at the White House by President Wilson was the distinguishing feature of the afternoon, which included also a trip to Fort Meyer, where special drills by the United States cavalry were witnessed.

The morning session opened with a paper entitled "Practical Hints on the Use of Portable Photometers," which was abstracted by the author, W. F. Little.

This paper outlines a desirable procedure in the conduct of photometric tests with portable apparatus. It discusses the planning of a survey; a description of the condition of the installation and precautions which should be taken to make the results useful; a method of testing candlepower, illumination intensity and brightness; good practise in the maintenance of photometric apparatus; photometric errors inhering in photometers and accessories, together with means of avoiding them; photometric accuracy and test results.

W. A. Durgin, Chicago, opened the discussion, predicting that the standard of portable photometric readings would be raised if the advice and suggestion set forth in the paper were carried out. Supplementing the list of accessories mentioned by the author he suggested the use of a portable truck upon which the photometer should be mounted. He added that absorption screens having definite coefficients are available which should be more generally used. Greater consideration should also be given to a means for checking brightness coefficients in portable photometers.

L. C. Porter, of Harrison, N. J., held that one of the greatest possibili-

ties for error in portable photometer use lies in variations in the impressed voltage of the test lamp which are not taken into consideration. In this connection the miliampere meter has been found very satisfactory.

E. A. Anderson, Cleveland, thought that the standardizing of the test lamp is of the greatest importance in photometric work. He also referred to the increasing use of portable photometers to measure beam candlepower of searchlights and projectors.

C. E. Rowe, Washington, considers the data book for observers of extreme importance. Printed blanks calling for exactly the information desired should be furnished observers. He thought it also essential to select representative locations for taking readings. It is frequently desirable to take photographs of the installation for reference purposes.

Norman Macbeth, New York, thought that the greatest field for portable photometric work is for determining average brightness of installations.

H. G. Stickney, Harrison, N. J., said that one source of error in determining intensity of a lighting installation is due to the shadow cast by the observer. Errors will also be found in the cosine values of most of th plates used. He added that observers not experienced in taking measurements frequently neglect to take into account burned out lamps, or effect of different lighting in different sections of an installation.

Norman Macbeth added that in taking measurements in industrial plants, schools, etc., the observer should take the position of the workmen or pupil so as to give consideration to the shadows encountered in actual use of the lighted area.

P. S. Millar, New York, stated that because of the apparent simplicity of the portable photometer inexperienced observers are frequently intrusted with making measurements. The paper contains invaluable advice and instructions for the inexperienced and should be carefully studied. Mr. Millar did not agree with Mr. Macbeth that the observer should occupy the position of the occupant of the room when making measurements. He thought that an entirely separate study should be made of shadows.

The paper entitled "Compensated Test-Plate for Illumination Photometers," by Clayton H. Sharp and W. F. Little was read by Dr. Sharp.

The errors of illumination test-plates due to their deviation from the theoretical cosine law have been studied experimentally. The most important cause for the deviation of test-plates from the cosine law is shown to be the increasing reflection with increasing incidence according to Fresnel's law. Test-plates may be compensated for the deficiency in brightness with light at large angles of incidence by admitting light to the posterior side of the plate in sufficient quantities. Transmitting test-plates are mounted on flashed opal rings of suitable width and light at 90 degrees is cut off by a metal screen. The results of this method of compensating plates are shown. The results of a test of illumination with compensated and uncompensated test-plates are given. The possible application to the integrating sphere is noted.

Ward Harrison, Cleveland, mentioned some experiences with various types of test-plates. He suggested that in making measurements lamps in various locations be turned off to determine the effect of burnouts on the installation. He thought the use of the polished test-plate referred to in paper will make far greater accuracy in photometric work.

Norman Macbeth, New York, pointed out that the setting of test-plate has an important bearing on the results that are obtained. He held that the reflecting test-plate when properly used is less liable to produce errors than the transmitting test-plate.

G. H. Stickney, Harrison, called attention to the test-plate brought out some time ago by W. D'A. Ryan which was intended to obviate the cosine errors.

The papers entitled "The Lighting of Ships," by H. A. Horner, and "The Lighting of a Passenger Steamer," by H. T. Spaulding, were read.

Mr. Horner states that, as in land practice, certain rules are laid down for marine installation, the requirements being contained in the code of the underwriting society under whose classification the entire vessel is constructed, in the regulations of the government under whose flag the vessel receives its protection, and in the specifications of the owner prepared for the purpose of guarding the builder in the specific details appertaining to the practice or trade of the ship. The two-wire system of distribution is usually adopted in merchant vessel practice in this country. Our navy has adopted the three-wire generator but not the three-wire distribution. A high grade of rubber for the wires, usually in excess of requirements, is specified. All appliances in any way subject to the effect of hydroscopic changes or exposures to salt air are made thoroughly water-tight. The paper discusses intimately the equipment of the generating plant, the searchlights, running lights and night signaling and fixtures. The conclusion is that the illuminating engineer has a large, varied and interesting field opened up to him in ship lighting. The work has hardly begun and will probably never end.

Mr. Spaulding introduces the subject of the lighting of a passenger steamer with a brief historical sketch of past and present practice in marine lighting. The lighting requirements of a passenger boat are discussed and compared with similar installations ashore. To illustrate how these requirements can be satisfied the author describes the lighting system designed by him, in co-operation with the architects, for the S. S. Noronic, a lake passenger boat, and gives the results of illumination tests in some of the more important portions of the vessel. In conclusion it is recommended that a departure be made from the ordinary boat lighting systems so common at present, and it is urged that a closer relationship between marine architects and illuminating engineers be established.

L. C. Porter discussed the papers at some length, pointing out that it has been particularly difficult for illuminating engineers to co-operate with ship architects and builders in designing scientific lighting. The consideration of lighting is usually left until the frame work is completed and consequently conduit and fixtures must be located wherever space is available, without regard to efficiency or esthetic conditions. He added that incandescent searchlights which now have a range of over one-half mile should find favor in merchant marine service. Flood lighting will also find favor for illumination of docks when loading and unloading ships and for illuminating barges and machinery when coaling ships.

At the street-lighting session, Preston S. Millar, chairman, an interesting paper by G. S. Barrows reviewed "Street-Lighting with Gas Lamps."

A paper entitled "Arc Lamps for Street Illumination" was read.

This paper, prepared as the joint effort of C. A. B. Halvorson, Jr., S. C. Rogers and R. B. Hussey, covers a brief history of the open carbon arc lamp, the enclosed carbon arc lamp, the open flame carbon arc lamp, the enclosed flame carbon arc lamp and the magnetite luminous arc lamp. The titanium carbide arc lamp is referred to incidentally. Principles of street lighting are discussed, and a brief reference is made to street arc lighting accessories. This portion of the paper is similar to a considerable extent to the article by two of the authors of the present paper which appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of September 4, 1915. Street-lighting practice is discussed briefly, and a reference is made to the use of flame arc lamps at the Panama-Pacific International Exposition. A valuable feature of the paper is the ap-

pendix, tabulating street-lighting practice with direct-current, series, luminous arc lamps, and adjustments, mean spherical candle-power and efficiencies of series arc lamps.

W. H. Robinson's paper entitled "New Types of Incandescent Lamps and Their Relation to the Street Lighting Problem," was read, followed by the paper entitled "A Practical Application of the Principles of Scientific Street Lighting," by F. A. Vaughn.

Dr. C. P. Steinmetz opened the discussion on these papers. He stated that the first application of electric lighting was for street lighting. The three principle factors in street lighting are source of light, distribution of illumination and color of light. With the development of nitrogen filled lamps the incandescent lamps became a formidable competitor of the arc and many believe that the arc will be superseded but Dr. Steinmetz said each has its field. The type C lamp has found an extensive field for street lighting where low cost is the principle item but magnetite arc lamps will always be used in high-class installations. The efficiency of the incandescent may be said to have nearly reached its limit while there is no limit to the efficiency that can be obtained in the arc. The incandescent lamp is much more flexible, ranging as it does from 40 candlepower to many thousand and any size can be used without a material falling off in efficiency. The arc lamp, on the other hand, is more rugged and less liable to be affected by extreme momentary variation in voltage. Problems of light distribution are becoming more and more complex and consideration is also being given color of light and its relation to surroundings.

At the close of the session a trip of inspection was made to the Capitol, Congressional Library and new Post Office building, arrangements having been made to keep the buildings open so that the interior illumination could be inspected. Street lighting installations in various parts of the city were then visited.

The report of the later sessions will be published in the next issue.

Low Fire Losses in Berlin.

United States Consul General Robert P. Skinner, recently stationed in Berlin, Germany, states that fire losses in Berlin are strikingly low. This is due, among other things, to the small quantity of wood used for structural purposes, the limitations of the height of building to 72 feet, and, no doubt, principally to the temperament of the people. All real (immovable) property in Berlin is required by law to be insured in the so-called Municipal Fire Society (Städtische Feuersozietät). The report of this institution for a recent fiscal year announced fire losses in the course of the year amounting to $260,529 on policies aggregating $1,314,367,233.

CONVENTION OF NEW ENGLAND SECTION, NATIONAL ELECTRIC LIGHT ASSOCIATION.

Splendid Meeting at Kineo, Me., September 14 to 17.

The seventh annual convention of the New England Section, National Electric Light Association, was held September 14 to 17 at the Mt. Kineo House, Kineo, Maine. About 400 were in attendance, including an unusually large number of ladies. Delegates arrived from Boston, Portland and New Haven, Conn., by a special train and special cars.

The reception on the evening of arrival, Tuesday, was remarkable for the mutual cordiality of all present. Those in the receiving line were President L. D. Gibbs and Mrs. Gibbs, Vice-President Walter S. Wyman and Mrs. Wyman, Miss O. A. Bursiel, secretary; Mr. and Mrs. Charles A. Mixer, Rumford, Me., and Mr. and Mrs. B. H. Gardner, Waterbury, Conn.

The technical sessions began on Wednesday morning. The annual report of Treasurer Robert W. Rollins was read in his absence by Howard T. Sands. It showed that expenditures for the year had been about $3,300 and that $793 remained in hand on September 1.

The report of the secretary was read by William Gould. It reviewed the Section work of the year, which included, besides the routine duties of the permanent office in Boston, the arrangements for monthly electrical luncheons and the valuable Question Box Convention of last spring, the promotion of joint relations with contracting interests, and of electric vehicle interests. An assistant to the secretary has been regularly employed. The Section membership is now 1,100, 246 members having been added since January 1, 1915. It was pointed out that the Section's helpfulness to various electrical interests is more than ever recognized at this time of business uncertainty. The various classes of membership are as follows: Class A, 124; B, 718; C, 13; D, 52; E, 193. An employment bureau, by which electrical workers would receive assistance in being advantageously placed was a suggestion in connection with the secretary's office.

President Gibbs, in his address, said, the Section had come to a point where there is no question of its permanence, and its value to the industry. He urged that certain permanent committees, consisting in each case of one member from each of the six New England states, be appointed, three of them for one year and three for two-year terms, with bi-yearly appointment of successors, each committee to meet four times a year and carry forward a continuous working policy. The eight committees suggested are: Membership, publicity and advertising, rates, co-operation with kindred organizations, commercial problems, discussion of papers, entertainment, and transportation. Mr. Gibbs pointed out with satisfaction that no Class D members in New England have withdrawn on account of the recent increase in dues for that class.

Isolated Plant Versus Central-Station Power.

The topic for the day was the subject of power, and concerned itself chiefly with the question why the central station does not get all the big power business.

The first paper was by John J. Gillespie, of the United Shoe Machinery Company, Boston, and its tenor was to the effect that in shoe-factory operation the central station is at a disadvantage as compared with the isolated plant, in that the latter can advantageously supply heat for warming the factory and for processes of manufacture, by the utilization of exhaust steam or steam from turbines, a pressure of about 35 pounds being needed in melting wax, heating the machines and drying the shoes. Mr. Gillespie argued that the manufacturer is concerned almost solely with costs, and is not interested in the technicalities in which power salesmen from the central station sometimes enshroud their propositions. If the latter could offer light, power and heat all at definite unit prices, their path would be clear of obstacles, he said. The central station might consider operating a heating plant at the customer's factory, serving electricity supply from the central station. In the case of a New York shoe factory in whose shoe-machinery installation the speaker was the advisor, this course was suggested, when the subject of factory motorization was being considered.

The paper was the source of an animated discussion, which, however, was reserved until after all the papers for the day had been read.

Another treatise on the same subject applied to various industrial plants, by H. B. Emerson, of the Arlington Mills, Lawrence, Mass., was read by John West, of C. H. Tenney & Company, Boston. This paper pointed out certain advantages of isolated-plant operation, viz., the utilization of steam for heating, shorter transmission, and closer control over the power plant. Figures were presented which tended to show that energy could be produced by a private plant requiring ten million kilowatt-hours a year, at less than one cent a

kilowatt-hour. The writer conceded that many industrial firms do not know what their power cost actually is, believing it to be much less than it really is. Fixed charges and incidentals often bring the figure well within the competition of central stations.

The same general topic, elaborated from specific experiences, was further presented, from the central-station standpoint, by K. P. Applegate, of the Hartford (Conn.) Electric Light Company. He held that if the central station charges a fair rate for power, gives reliable service and makes use of a business policy, there is no reason why at least 70 per cent of the power business should not be connected to its lines. There are only three reasons for the existence of a source of power other than the central station: (1) where the central station is at fault in not going after large power business; (2) where the isolated plant has other reasons aside from cost for making its own power, and (3) where the isolated plant must supply much steam for heating, the power used being a small percentage. Several instances were cited of manufacturing plants which were solicited for their power business but which failed to change over to central-station power, because of reluctance to yield their independence, because steam was required for heating, because of lack of checking between the factory's and station's engineers, or for other reasons. In cases of small manufacturing plants, using under 100 horsepower, the costs of changing over are sometimes a barrier which can be removed by the central station carrying a part of the expense. Some factories requiring steam heat operate their engines during the cold season and buy central-station power the rest of the year.

In conclusion, Mr. Applegate said: "If all the isolated plants are to be displaced, it must be accomplished by the education of the men in control of them. Some of the important items in which they should be versed are the following: How the extra money that an isolated plant costs could be made to produce larger earnings if placed in their business; how each manufacturer should keep to his own particular product and not go into the production of power; and what load-factor is, and how it affects costs. The central station must educate its prospects so that they can figure their own costs and thus make a fair comparison with the kilowatt-hour costs to be billed them by the central station."

Application of Station Power to Large Mills.

James E. Arthur, of the Boston Edison Company, said that the most favorable time to approach a factory manager is when a change of his equipment is necessary. At this time he will readily discuss the cost of production. "The value of central-station service to the manufacturer depends directly upon his own cost of production, which in turn is dependent on the size of his plant. Money invested in a power plant has no real earning capacity beyond that of producing power, and this item is a very small percentage of the total cost of manufacture," said Mr. Arthur. "The same amount of money invested in stock and machinery would bring far greater returns."

The speaker pointed out that money tied up in fixed plant investment that is non-productive and not quickly negotiable tends to weaken a manufacturer's credit, while the same amount of liquid capital is very advantageous. Showing the small percentage that light and power costs bear to the whole cost in the manufacture of shoes, Mr. Arthur stated that for shoes costing $2 a pair materials represent 40 per cent, heating and overhead 39 per cent, labor 20 per cent and power and light 1 per cent. The money invested in his isolated plant if available as working capital, would render the manufacturer larger returns in the reduction of overhead and materials costs than any slight economy in the cost of power. Mr. Arthur therefore held that the application of central-station service to large factories is a financial rather than an engineering problem.

Jesse E. Gray, of the Narragansett Electric Lighting Company, Providence, R. I., presented some practical suggestions on the best methods of interesting factory owners in station power. He said: "Competition between the central station and the factory is usually between an outside source of electricity and electric energy generated on the premises, so that the advantages of electric drive are no longer a factor. We must convince the prospective customer that the cost of operation will be less with central-station service.

"The best way to do this is to make a thorough test and inspection of the plant, obtain the various items of cost entailed in plant operation and incorporate the data in a report, together with the cost of installing and operating the plant with station service. The report should be clear and concise and free from technical terms."

The report might well be divided into four sections: description of present plant, present cost of operation, proposed changes; cost with central-station service. The Narragansett Company submits detailed reports of 20 to 30 pages, bound in black Morocco and lettered with the prospective customer's name. They are of such a size and shape as to preclude being pigeonholed.

James E. Spike, of the Cambridge (Mass.) Electric Light Company, which has 521 power customers connected to its lines, said that many of its prospects are connected as the result of a careful investigation of installations already in operation, believing that central-station energy supply is the most reliable and economical power for the operation of most industrial establishments. The central station of the University City has a power load which includes such diverse establishments as Harvard College; John P. Squire & Company, pork packers, with 1,945 horsepower; Gray & Davis, automobile accessories, 485 horsepower; Blake & Knowles Pump Works, 464 horsepower; University Press, 200 horsepower; Davis Ice Cream Company, 225 horsepower. The installations of Gray & Davis, the University Press, Davis Ice Cream Company, and of the Widener Library at Harvard, have been described in detail in previous issues of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.

The next paper, on the same general topic, was by John West, of C. H. Tenney & Company, Boston. He dismissed the proposition of the central station acquiring *all* the big power business as being impracticable, owing to the geographic, legal and financial problems, such a condition requiring a combination of all central stations so that maximum use could be made of all investment, and the utmost economy of operation effected. This would mean a virtual monopoly. "How to get all the *profitable* power business in our territory at rates consistent with reliable economical service is a practical consideration," said Mr. West. He indicated how central stations could take advantage of situations where quality of power service rather than cheapness is the important consideration. Often central stations have been called upon to supply a product of better quality than their competitors at the same or lower costs. This is unfair; the remedy lies in constantly emphasizing, in advertising and soliciting, the true value of the service—its reliability, flexibility, the larger returns on capital of manufacturing companies that may be invested in stock rather than plant.

"True power economy is a ratio as represented by the total cost of power, heat and light and the gross valuation of the product manufactured. The manufacturer may be interested in saving money, but he is far more interested if a method can be shown him for making a larger amount of money without in-

creasing his costs," said Mr. West. He claimed that in New England the rates for electric service are sufficiently low to get the business in competition with isolated plants. The diversity of rates is often a puzzling problem with manufacturers, and the power salesman should be able to explain the reasons for their diversity. The manufacturer is not especially interested in any rate schedule, but he is vitally concerned about the total cost of his power, heat and light.

Mr. West suggested the establishment by the Section of a central-station-power bureau, to distribute information relating to power business obtained and the mode of meeting competition, to obtain data on the cost of operating private plants and to render estimates on the cost of central-station-power service for central-station members of the Association. Such an arrangement would enable smaller companies, at small cost, to have expert selling advice, which would diminish the chance of erroneous estimates and more than compensate for small expense entailed on the Section.

The Subject from the Hydroelectric Standpoint.

The first paper of the afternoon session was by H. W. Eells, of the Central Maine Power Company, Augusta. Mr. Eells believed the central station had not gone after the power business vigorously enough, and that it is bound to fall to the central station in course of time. Companies advantageously situated for such business are those which generate by water power, those having steam plants of large capacity and highest efficiency and those enjoying the advantage of water-borne coal. Such plants readily dominate the situation with respect to manufacturing establishments not enjoying these advantages. The difficulty of interesting paper manufacturers, saw mills, laundries and other plants demanding steam for heating or process work, was recognized by the speaker, who pointed out the recent introduction of electric heating devices which, as perfected, will meet the heating argument. Even the problem of waste products used for fuel in factory steam plants is being solved by the more profitable disposal of these wastes, such as sawdust and shavings.

Even the well planned mechanical drive can be displaced as it becomes obsolete and new or additional power requirements are imperative. It is often possible to sell power for motors installed to take care of additional work at a mill, later gradually substitute central-station electric for the original mechanical drive. Practically any difficulties in the way of securing business must be met with enough other benefits to offset them. Time and patience are the remedies for individual difficulties.

Mr. Eells said that the Maine central stations have little of the difficulty in securing big power business such as is found in communities which depend entirely on steam power or on hydroelectric power transmitted a long distance. In that state it is rarely necessary to send current more than 30 miles, and the type of line construction being relatively inexpensive, there is small chance for steam power to compete directly with electricity. It has been possible to secure practically all industries, except sawmills, which have no water power of their own. The hydroelectric development of Maine has been in close touch with its industrial growth. Privileges have been acquired where the power has been in use by a prosperous mill which continued to do business, taking electric in place of the water power. Beneficent results to both parties are the more efficient equipment of the central station and the superior reliability of the power used by the factory. Often the mills and the electric companies have common interests, and in some cases the manufacturing interest has secured the central station, instead of the reverse.

Sometimes in practice the central-station service is connected to the individual or group-drive motors and to a motor which is belted to the main water-wheel drive. The result is maximum efficiency for the water power, since the gate can be set to pass only as much water as is available and the central station takes the rest. This gives the consumer all the flexibility of control which is possible with electric drive and at the same time makes advantageous use of the water power. Speed control comes from the central-station service, and the flywheel effect of the customer's turbines helps to prevent sudden speed changes in the central-station service. To prevent inaccurate meter readings through current feeding back at times of light demand, the service meter is equipped with a ratchet dial.

An interesting situation exists at Dexter, Me. Here several mills are located on a stream emptying from a pond. Except during extremely high water, the flow is entirely shut off at night. In the morning the first mill on the stream is able to start with water, without delay, but the mills downstream have to wait for the flow to reach them, causing delay. Before electric service was introduced they were obliged to start on steam, for which they had little use after a short time. Now they start with electric power and later take over a part of the load on water as it comes to them, but continuing to float in with the electric power all day. These mills are not large enough to affect the system's peak, and since they start between 6 and 6:30 a. m., the effect is to fill in the early morning valley of the load curve. The water power is in full use later in the morning, when the power peak comes, and thus the arrangement has the double tendency to straighten out the load curve.

It is found in Maine that water-power supply is not apt to follow power demand, there being times when little power is available and the demand great, and vice versa. If it were possible to combine the power supply of a group of industries, and their power demand were taken from a common source, Mr. Eells pointed out that all the advantages of diversity-factor would unite to give a more uniform power supply with little increase of capacity. Under these circumstances it is logical that all power business in a given territory should be handled by the central station either through purchase or lease; under this arrangement specialists could work out economies of operation by operating such plants as are necessary and taking full advantage of the available stream flow.

The practice of lighting companies in renting motors for mills and factories was the topic of a paper by G. F. Parsons, of C. D. Parker & Company, Boston. This will be summarized in the next issue.

Standardizing Motor Voltages.

The standardization of motor voltages was the subject of a paper, also by Mr. Parsons of the Parker Companies. There are in New England 23 central stations serving two-phase, 220-volt energy; 6 with two-phase, 440-volt; 102 with three-phase, 220-volt; 6 with three-prase, 440-volt, and 36 serving three-phase, 550-volt energy. Direct-current power is now little used. The comparative populations in territories of central stations serving the various types of power are:

2-phase,	220-volt,	60	cycle	360,997
2-phase,	440-volt,	60	cycle	165,358
3-phase,	220-volt,	60	cycle	3,247,165
3-phase,	440-volt,	60	cycle	174,981
3-phase,	550-volt,	60	cycle	1,568,788

It was pointed out that the reason for the great predominance of stations supplying 220-volt service may be due to the small central stations so located as to have a limited field for procuring power business. They supply the voltage which does not require a special investment, furnishing 220 volts by using lighting transformers.

Charts were presented showing graphically the ratio of central stations supplying a given voltage to the whole number, and the relation of motor sales at certain voltages to all voltages. The predominance of the 220-volt motor is marked. In the sale of 220-volt motors 3 and 5 horsepower form the larger

portion of the sales. In the 440 and 550-volt sales the larger-sized motors predominate. Motors of 110-volts are not found above 15 horsepower capacity; 25 horsepower is the dividing line between motors of 220 volts and units of 440 and 550 volts.

Motors of 5 horsepower and under show a value of 62 per cent of the total number of motor sales. More than 10 times as many 220-volt motors were put in service as of 110 volts, and 2.9 time of 440 volts and 5.4 times those of 550 volts.

The history of the power business indicates that with the growth of demand there was a response with voltages of 440 and 550 where the business warranted. Efficiency and practical operation, balanced with first cost, were the determining factors. For the same power delivery the circuits for 440 volts would have to be 56 per cent larger than for 550 volts, while 220 volts require 6.25 times the copper required for 550 volts. The saving in copper cost is a large item. In general, 550-volt service gives the lowest first cost of installation on large motors.

The results of a study of large mills in New England which are electrically equipped, but manufacture their own power show:

Voltage	No. of Installations	Capacity H. P.	Per cent of total No.	Per cent of total H. P.
220	6	9,675	12.8	8.0
440	12	23,050	25.6	18.9
550	29	89,825	61.6	73.1
	47	122,550		

Data compiled on textile mills to the number of 1,000 installations all over the United States indicate that 550-volt installations predominate, both in number and capacity. The speaker pointed out that the predominance of the lower voltage in central-station service was due to the fact that this pressure was established when their power business was small, while the large factory installations have been determined by engineers mainly on the basis of copper cost. It was argued that it would not be just for a central station to supply 550 volts for a three-phase installation of 5 horsepower or smaller motors, nor reasonable to demand 220 volts for 50 to 100-horsepower installations. The purchaser of current would gain nothing in either case, while the lighting company would have to provide transformers that would not be changeable with the rest of the service. A central station should not be required to furnish 220 volts for power when the capacity of the transformer required would be larger than those used for supplying its lighting service.

Mr. Parsons advocated the standardizing of 220 and 550 volts for motor services. The 440-volt service was termed a relic of the past, as well as the two-phase system, both of which were developments of the pioneer state.

In most of the Parker Companies the following is the rule for power services:

Installations Aggregating	
1 to 2 horsepower	110 volts, 1-phase
2 to 7.5 horsepower	220 volts, 1-phase
7.5 to 25 horsepower	220 volts, 3-phase
25 and over	550 volts, 3-phase

"This practice gives both purchaser and central station a fair deal," said Mr. Parsons.

Advantages of standardization were held to be as follows: The small consumer can move to new locations and find conditions adapted to the use of his motors; all motors would have a greater resale value and quicker deliveries would be possible; eventually the cost of motors might be lowered, due to larger production of fewer types; manufacturers would welcome a standardization, as it would simplify the parts necessary for adapting motor drive to their machines; the large motor manufacturers would reduce capital tied up in stocks; machines and storage space in manufacturing motors would be reduced, it would permit uniformity of meters and transformers.

Most central stations have a 2,200-volt distribution system. These are in favor of a 550-volt standard. The suggestion was made that if a transformer can so easily be made for 110, 220 and 440-volt taps, why not for 550 volts?

Discussion on Power Papers.

Henry I. Harriman, of the Connecticut River Transmission Company, led the discussion, which included views on the general topic of power from central-station sources. Mr. Harriman said the output of central stations in New England is 200 kilowatts per capita, while that of the Western states is 400 to 500 kilowatts and that of the Pacific states reaches as high as 740 kilowatts in California. New England has the largest demand for power of any section of the country except the Pittsburgh and Gary districts. He cited the greater reliability of central station power over that of the private plant, mentioning two textile mills in which both turbines broke down inside a month. Had there been no breakdown connection, great loss would have been suffered, as war orders were being executed. Another advantage of central-station service is its flexibility, allowing factories to add motors here and there and to run overtime. It also frees the manufacturer from anxiety as to his plant. In a plant valued at $100,000, in which the power station's cost would be about $20,000, 6.75 per cent would have to be earned to equal 6 per cent were the factory taking central-station power.

The one central-station problem, said the speaker, is salesmanship. Engineers' language is generally too technical; it is not understood by the mill proprietor. It is better to select a naturally endowed salesman and add technical knowledge in sufficient quantity than to pursue the reverse course. Manufacturers should be approached from their own basis. Contracts should be simple, showing what net costs will be. Each mill of a type may be depended on to use power on about the same terms; consequently it is up to the central station to make a clear-cut offer. As in furnishing lighting, adopt a standard rate for power, the speaker urged. On the question of heating, Mr. Harriman said perfect frankness should be the rule in dealing with situations where steam is rquired ordinarily for heating or processes, and if electrical supply is not advantageous no contract should be urged, but rather discouraged, until conditions changed.

To show the diversity of rates charged for supplying 20 horsepower motors, the speaker said one New England Company charged as low as $42 per month, while another, the highest, charged $119. For 100 horsepower, the lowest is $87 and the highest $414. The Committee on Rates might properly see if uniform power rates for the same service cannot be made in territories of similar characteristics.

If the question comes to public regulating commissions it will be shown that somebody is too high and others perhaps too low, said Mr. Harriman.

Howard T. Sands, of the Tenney Company, agreed with Mr. Harriman that power salesmanship should not savor too much of engineering. Salesmen do not often realize how good a proposition is theirs. A mill doing a $2,000,000 business a year paid $6,500 for its power. A block plant securing the contract saved the concern $650 a year,—an infinitesimal per cent on the business; negligible, considering the risk. Mr. Sands did not believe lighting companies should undertake the heating of buildings. He referred to a manufacturing company that has contracted for 4,500 kilowatts, resulting from the destruction of its original plant, which was steam-driven.

James E. Arthur, of the Boston Edison Company, said that steam is not so important a factor in shoe manufacturing as was claimed. In the Brockton and Boston districts many shoe factories are motor-driven with central-station service.

D. M. De Bard, of the Brockton Edison Company, said that in that city 4,500 kilowatts are used by shoe factories. Seventy per cent of the energy is furnished by the central station.

Mr. De Bard related the company's practice in renting motors. The plan

was inaugurated in 1906 and has been the deciding factor in landing a large number of good, permanent power customers. Motors are furnished for new factories on a lease or easy-payment plan. The customer signs a lease and makes a 10-per-cent cash payment, after 5 per cent has been added to list price of the motor to cover interest. The remaining 90 per cent is divided into 11 monthly payments. At the end of the year the plate which the motor carried, stating that it was the property of the Brockton Edison Company, is removed, all payments having been met.

The readiness with which shoe factories are enjoying central-station power has been greatly facilitated since the announcement last July by the United Shoe Machinery Company that it was prepared to furnish electrically-heated Goodyear welt and shoe-sewing machines and bobbin-winding machines. These new devices cut the ground from under the argument that steam is necessary in shoe-making processes, as has been the case hitherto. The record of three weeks' operation of the electrically-heated welting machine installed in a Brockton shoe factory is as follows: Demand, 5.3 amperes, 110 volts; 48,384 pairs men's shoes welted, requiring 1,082 kilowatt-hours for heating wax pots. The electric consumption was 2.23 kilowatt-hours per 100 pairs of shoes. The average rate charged was 2.45 cents a kilowatt hour. On this basis, the heating cost was 5.46 cents per 100 pairs of shoes, where with steam it would be close to 50 cents per 100 pairs. "With the introduction of these machines," said Mr. De Bard, "the shoe-factory steam requirements are reduced to a low-pressure heating proposition with the safety valve set for 15 pounds and operated by any laborer working part time."

Under the motor trial proposition of the Brockton company, it furnishes and installs at its own expense all motors and other electrical equipment necessary to the economical operation of the factory and allows the use of this equipment for one year. Plans and specifications for the wiring and hanging of motors are submitted to two or more local contractors, and the job is awarded to the lowest bidder. The customer pays in monthly installments, as a rental, 15 per cent a year on the total cost of the installation. At the end of the year the customer is the judge as to whether the installation is satisfactory, and if so, buys the equipment at cost, less 60 per cent of the amount paid as rental. If not satisfactory, the company will remove all its electrical equipment in 60 days.

The result has been, that out of trial propositions amounting to 2,500 horsepower, the company has lost only one proposition, of 115 horsepower. The cost of installing was $42,400, an average of $16.96 per horsepower, all of which was returned to the company with 6 per cent interest, except the loss, of about $1,000. The yearly average gross income from the 2,500 horsepower has been $65,200, or $26 per motor-rated horsepower a year.

The Abington & Rockland Company in Massachusetts, another Stone & Webster company, has worked the trial proposition with good results. Its connected load is 2,810 horsepower, about 20 per cent of which has been secured by the trial plan. The connected motor load of the Brockton company has grown from 892 horsepower in 1906 to 7,641 horsepower in 1915, and about 37 per cent of this load has been secured through trial propositions.

C. A. Mixer, Rumford, Me., remarked that mill men often know as little on what a horsepower is as what a kilowatt is. He pointed out that with steam generation a station is capable of indefinite increase of capacity, while a hydroelectric station is limited by the stream flow. In addition to the two higher proposed standard voltages for motor service—220 and 550—there should be one of 2,200. Formerly motors of this voltage were forbidden in mills by insurance companies, having to be located outside factory walls. This rule has been rescinded. A company in Rumford has 450-horsepower motors of 2,200 volts installed in its mill. Motors of this voltage as small as 100 horsepower are connected to the Rumford Power Company's services.

In connection with the question of standardizing voltages for factory motor service, R. E. Simpson, engineer for the Travelers Insurance and Indemnity Company, Hartford, Conn., sent the following communication: "Many reasons have been advanced in the past for the use of high voltages for mill and factory motor service, the greatest emphasis being laid on the reduction in the cost of installation and the higher efficiency of power transmission made possible by voltages of 200 to 550, as compared with lower potentials. If the reduction in the cost of installation and the increase in efficiency by means of high voltages could be obtained without any disadvantages, these potentials would be very desirable. It is necessary, however, to remember that very few mill workers are acquainted with the dangers of electricity except in a superficial way. The records of accidents from electrical causes in mills indicate that employees will do careless and unexpected things around electrical apparatus. The unavoidable accidents from electrical causes are not great in number when compared with those brought about by thoughtless or careless acts of the employees. Other things being equal, the chances for accidents are greater in the mill equipped with a high-voltage installation than in the mill where low voltages are used, and this will have an important influence on the mill owner, especially in those states where workmen's compensation laws have been enacted. The observant mill owner will not permit the introduction of high-voltage drive if the gain thereby may be offset by damage claims paid to injured workmen. If a voltage of between 200 and 550 is standardized, it would seem that the interests of the central-station industry as well as that of the workers in mills and factories would demand definite provisions for safety."

Frederick Cutts, of the General Electric Company, New Haven, Conn., stated that the use of 2,200-volt motors in the South is not unusual, and has not been attended with casualties. Many units of 550 and 440 volts are now in service, but the latter voltage is likely to be eliminated in time. It is of advantage to manufacturer and user alike that voltages be standardized at the three suggested pressures, 220, 550 and 2,200.

Jesse E. Gray, Providence, R. I., said a plan for heating had been worked out in that city. The Providence Steam Company, a subsidiary of the Narragansett Electric Lighting Company, contracts to furnish heat, light and power at a fixed price for one year. The steam company contracts with the lighting company for its electricity at standard rates.

C. B. Burleigh, General Electric Company, pointed out the wide diversity of power rates as a severe handicap to the industry. Continuing along lines suggested by Mr. Harriman, he stated that for a 500-horsepower motor installation operating at 50 per cent load-factor, and using 43,600 kilowatt-hours a month, rates range from $481 to $1,267. For 1,000 horsepower, at 75 per cent load-factor, using 130,923 units a month, rates range from $1,309 to $3,273. Rates per month for a 20-horsepower installation at 80 per cent load-factor, under varying operating conditions, are as follows:

	Highest	Lowest
Water power and overhead distribution	$42.54	$104.38
Efficient steam plant, tide-water coal, overhead distribution	66.00	90.00
Steam plant, over and underground distribution	58.00	119.00
Inefficient steam plant, railroad coal	62.00	111.68
Fuel engine plant	81.00	106.00
Purchased current (Mass.)	79.00	88.00
Steam and water power plant	55.00	94.00

It was remarked that the lowest figures were not from water-power stations, but from a plant having a non-condensing steam engine, railroad coal and operating in a sparse territory. Mr. Burleigh urged that the Section take up the matter before the authorities get a chance to do so.

K. P. Applegate, Hartford, Conn., said that his company charges $5 per month minimum for an installation of 5 horsepower or less. Over that, $1 per horsepower a month. It leases motors for a term of one year, 25 per cent of the cost down, the balance on easy payments, with interest at 6 per cent on the 75 per cent of cost remaining unpaid.

J. J. Gillespie, of the United Shoe Machinery Company, closed the discussion. He cited a case of a manufacturer using a 100-kilowatt turbine, who produced his power, light and heat at $41.50 per kilowatt. The central-station offer was $60 per kilowatt. He agreed with Mr. Harriman on the advantages due to flexibility, reliability, etc., in favor of central-station power, and conceded that for less than 100 horsepower this source is to be preferred. He recognized the great desirability of emergency connection with the central station, but urged that it should not be made a basis for penalizing the factory for its non-acceptance of full service.

Addresses at the Banquet.

Attendance on the banquet by President E. W. Lloyd of the National Electric Light Association and three New England public service commissioners lent interest and importance to the occasion. Mr. Lloyd came all the distance from Portland, Ore., to attend. Toastmaster Louis D. Gibbs introduced him as "one who has spent many years of hard work in national and section activities."

President Lloyd said that he proposes this year to visit all sections of the country and point out the educational benefits to be derived from association with the N. E. L. A. The organization now has about 10 geographical and state sections, and many company sections. Thirteen hundred company members and 14,000 Class B members are enrolled. More than 500 men are devoting their time freely to reports, technical papers, etc., giving to the companies information unequalled in any technical organization in the world.

Ten or 15 years ago, said Mr. Lloyd, most of the papers were technical in character. The recent trend is toward the commercial side of the industry. In the reorganization four divisions of work have been developed—commercial, accounting, technical and hydro-electric, and a manufacturing section, to be formed soon. Each division conducts its own affairs through its own officers, devoting its energies to its special field.

The dearth of salesmen with sufficient technical training, and of college-bred men in the commercial departments, especially in the West and South, is to be remedied if possible, the former condition by means of correspondence courses, and the latter through the work of a committee to interest college men in the electrical business.

Of the public service commissioners of the six New England states, all of whom were invited to the convention, the chairman and another member of the Connecticut Commission, and the chairman of the Maine Commission were present. Judge B. F. Cleaves, of the Maine board, voiced the "layman's" view of the electrical industry in the state, he having but recently been inducted in office. "If public service commissions are to live and be of use," he said, "they must be regarded by the public and by the public service companies as the third member of a close and somewhat intimate copartnership." He remarked that the public anticipation that the Commission would uncover frauds had been disappointed. The public, however, wants consolation for its disappointment. He advised the companies to enlighten the Commission on all matters to be passed on. "Don't force us to drag out information," he said. "Let the public not only receive fair treatment, but also believe they are receiving fair treatment."

Chairman R. T. Higgins, of the Connecticut Commission, said that state regulation has come to be an established principle. He remarked that it is easier and better to do business with people one knows. "What is for your good is for the good of the public," he assured his audience.

Vice-President Walter S. Wyman said that a new era had arrived in the central-station industry. Systems are coming in closer relations. The central station is in business to make money, and to save the public money. No man cares what his neighbor pays, he said, providing he can get a product as cheaply as other men get it. Maine lighting companies are doing scarcely 10 per cent of what they ought to do; when they are developed to that point they will be able to reduce their rates one-half.

Public Service Commission Session.

The morning session on September 16 opened with a stereopticon lecture by D. M. DeBard, of the Edison Company of Brockton, Mass., on the manufacture of war shoes by a firm in that city which had built and equipped with motored machinery a large addition to its factory, in the brief time of two weeks and two days. The factory already had 117 horsepower in motors, using 15,000 kilowatt-hours a month, and now has 245 horsepower, which consume about 60,000 units a month, the factory being operated 24 hours a day. Processes formerly requiring steam heat are now performed with electric heat, and the finished product is shipped by electric freight, making the entire cycle of operations electric.

President Lloyd spoke on Association work as directed to the question of rates. Lighting companies have not discriminated in rates with any motive other than to secure a large volume of business, which results in the lowering of all rates. He pointed out that the cost of delivering energy is a large per cent of the cost of service. Artificial ice manufacture in Chicago was referred to as a desirable load, having no peak demand, the process being suspended from 4 to 8 p. m. There are in that city about 20 ice plants, each calling for about 300 kilowatts. The rate having been based on the Hopkinson schedule, the company found that it could halve the demand charge of about $20 a year, with the result that the net rate is about one cent a kilowatt-hour. The maximum power rate of 10 cents is not out of proportion, owing to the cost of getting the service to the small consumers, Mr. Lloyd said. The cost of handling accounts, including meter depreciation, was given as 46 cents a month. The Commonwealth Edison Company has a minimum of trouble over rates, because of its practice in setting them forth clearly. This facilitates the solicitor's task in interesting factory managers in the power business.

C. A. Carpenter, of the Martha's Vineyard and Buzzard's Bay Companies in Massachusetts, pointed out the desirability of central-station men knowing the public service commissioners of their state. It is well to drop in at their office for a friendly chat, and if in doubt as to the best policy as to rates, to ask their advice. Mr. Carpenter alluded to Tesla's prediction that electrical energy will ultimately be sold by the outlet, rather than by measure.

Bowen Tufts, of the Parker companies, Boston, called attention to the large number of small shareholders of electric lighting securities. In Massachusetts there are 30,000, with holdings averaging $1,500. Just as the Savings Bank Commissioners closely guard the interests of the depositors, so the regulating commissions should safeguard the small investor in public utilities.

B. H. Gardner, Waterbury, Conn., said that there should be no difficulty in explaining demand rates, these being readily transmitted to horsepower.

The customer that costs 50 cents a month to carry is not yielding a profit on his summer business. Attention should be given to the matter of recouping the company for fixed charges, in all cases.

Eugene Carpenter, of the Martha's Vineyard and Buzzards Bay Companies, explained the difficulties of summer-resort business on a meter basis. His companies have recently abandoned metering of energy and established flat rates. Meters and connections at $25 each would represent an investment of $50,000 for the companies' 2,000 customers. The cost of reading, testing, etc., would involve an expense of almost $5,000 a year.

Under the new plan, bills can be made out by the office force at any time and mailed the first of the month. Small customers will ultimately be on a three-ampere limiting fuse to prevent the attachment of domestic appliances where only lighting is provided for by agreement.

Commissioner Elwell of Connecticut spoke humorously of his early experiences as a Maine boy. During his career as engineer for the Connecticut Commission, which office he held until recently, his policy was to enlist the interest and services of railway men in formulating and putting in effect safety rules rather than asking the Commission to impose them on the companies.

Chairman Higgins of the Connecticut Commission said the duties of a Commission are not to solve operating problems, but to see that a company gives good service at reasonable rates. Safety in station operation and transmission is also in their province. "Honest capital in electric companies should be sufficiently rewarded to induce the investment of new capital," said the commissioner. A commission never establishes a minimum return on capital; hence it should not set too limited a maximum. A regulating body owes it to the corporations to see that it is getting justice.

Mr. Higgins believed the system of reporting to commissions should be simple and readily understood by the public. For his own part, he said, he will be glad to co-operate with the companies. The result of commission work will be a better feeling between the public and the corporation, he maintained.

Chairman Cleaves, of the Maine Commission, said the American public is inclined to be fair, even generous. If he is sure he is not being discriminated against, a man will spend $2. where he will kick at being robbed of two cents. Referring to the rate difficulty, Judge Cleaves recalled that under early conditions electric plants were started and operated by local men, and their friends were given preferential rates. The companies having special agreements were urged to abolish them. The Maine Commission, the most recently created, proposes to proceed slowly and safely, he promised.

Howard T. Sands said that public utility companies are coming to realize that they are public servants. Broadly speaking, he said, there is no reason why municipalities could not apply the same efficiency and economy as is the rule in private enterprise, but politics and the lack of personal incentive prevent. Competition failed to adjust, and monopoly was repugnant. Hence Massachusetts instituted its regulating commission—the first of the kind in the country—in 1885, as a corrective of possible abuses. The public is inclined to be fair, said Mr. Sands, but people are too much prone to accept newspaper reports that reflect on corporations. He believed in control and regulation, and urged frankness and co-operation with regulating bodies.

N. J. Neall, consulting engineer, Boston, urged the Association's support of the plan for standardizing modes of accounting and returns to the public service commissioners of the various states. He pointed out the diversity of requirements now imposed by the several states.

Recommendations of a joint committee of central-station men and electrical contractors of Massachusetts was the subject of a report read by Walter L. Mulligan, of the United Electric Light Company, Springfield, Mass. This will be given in a following issue.

J. M. Wakeman, general manager of the Society for Electrical Development, explained plans for Electrical Prosperity Week.

The Electric Vehicle Committee of the Section rendered a report through E. S. Mansfield, chairman. This will be summarized in the next issue.

High-Efficiency Lamps.

The final subject was the high-efficiency incandescent lamp, the technical aspects being presented by Henry Schroeder, Edison Lamp Works, Harrison, N. J., and the commercial end by C. A. Dean, Cambridge (Mass.) Electric Light Company.

Mr. Schroeder outlined the new principles of lamp construction, and said that experience gained during the past year, and new gases used, have permitted the manufacture of lamps as low as 100 watts, in the 110-volt range. On account of the cooling effect of the anchors, the larger sizes are made with the bottom anchors omitted, so the lamp can be burned tip-down only, but special lamps, of slightly inferior quality, can be supplied for tip-up burning. Owing to fire underwriters' rules, the 300-watt lamp, formerly fitted with medium screw base, is now standard with mogul screw base; at the same time the change was made the light center length was increased slightly, so that it can now be used in fixtures and reflectors designed for 400 and 500-watt lamps. Mazada type C lamps of 200 to 1,000 watts, in voltage range of 220 to 250, are now available, made in the same bulbs as 105-125-volt units.

Standard street series lamps of 60 candlepower and over for standard circuits of 5.5 amperes and upward are now of the Mazda C type. The efficiency of the 15 and 20-ampere lamps has been steadily increased, the 1,000-candlepower unit now operating at 0.45 watt per candle. Though giving satisfactory lives, series Mazda C lamps are not at present recommended for direct or rectified-current series circuits, because when the filament breaks the arc formed is liable to work up into the base and burn up the socket. Practical methods for short-circuiting the lamp before such damage can occur are being developed.

The use of the new lamps for locomotive headlights, stereopticons and flood lighting were referred to. In all these fields the gas-filled tungsten is preeminent. To meet the demand for low-wattage lamps with concentrated filament and a white light, a line of 25, 40 and 60-watt Mazda coil lamps has been developed, for spectacular lighting. These are vacuum lamps; if gas were introduced, in the present stage, they would not be so efficient, said Mr. Schroeder, because the cooling effect of the gas would be so great that an excessive amount of current would be required to keep the filament up to temperature. Up to the end of July about 1,500,000 Mazda C lamps have been sold in the United States, representing an increased income of over $25,000,000 to central stations within a year. A 7.5-watt, 110-volt Mazda sign lamp, not of the Type C, has been developed recently, which gives about 5 candlepower and will probably increase the sign lighting business greatly. Its rated average life is 2,000 hours.

Mr. Dean's paper will be summarized in a later issue.

Election of Officers.

At the end of the session officers of the Section for 1915-1916 were elected as follows:

President, Walter S. Wyman, Augusta, Me.

Vice-president, R. W. Rollins, Worcester, Mass.

Treasurer, Bowen Tufts, Boston, Mass.

Executive Committee: A. H. Ford, Maine; R. D. Smith, New Hampshire; W. H. Vorce, Vermont; C. R. Hayes, Massachusetts; A. B. Lisle, Rhode Island; G. B. Leland, Connecticut.

Miss O. A. Bursiel will continue her efficient work as secretary.

Central-Station Rules for Service Connections, Wiring, Etc.

A very interesting book with many illustrations and comprising a total of 86 pages has been published by the Commonwealth Edison Company, of Chicago, giving "Rules and Information Pertaining to Electrical Service, Meters, Wiring and Motors." This book has been drawn up for the guidance of contractors, architects, engineers and the company's customers in general in regard to what are standard methods of wiring where central-station service is to be supplied. These rules have been established as the result of many years of experience and give what are believed to be necessary requirements in order that this large central-station company may be able to give the best service to the greatest number.

This book explains the systems of distribution used; then follow rules for connecting service, for general wiring, and for installation of motors, meters and lamps; inspection rules are given and a number of valuable tables.

Formal Opening of Commonwealth Edison Company's New Office Building.

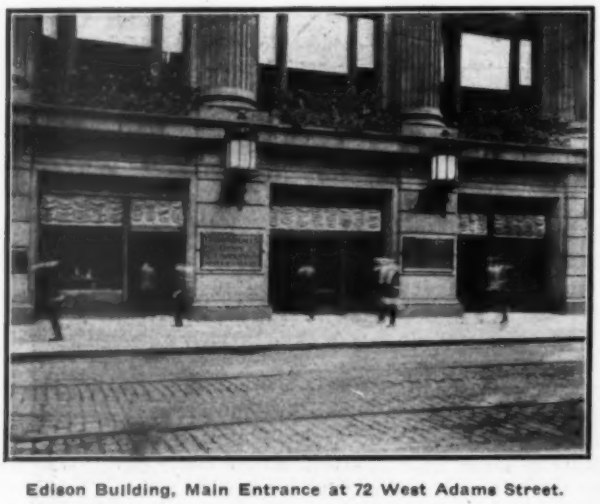
The spacious new quarters of the Commonwealth Edison Company, Chicago, embodying every possible facility for rendering prompt, courteous and efficient service to the customer were formally opened to the public during the week of September 20 to 25. Invitations were sent to all of the company's customers and arrangements made to provide demonstrations and entertainment in keeping with the importance of the occasion. The Commonwealth Edison orchestra furnished music during the afternoon and evening and motion-pictures, pertaining particularly to matters of electrical interest, were shown each day. Specially detailed employees were on hand to conduct the visitors to the various points of interest and answer queries relative to Edison service or electrical appliances.

New Edison Building, Chicago, Illuminated for Grand Opening.
(Dark offices are those of non-electrical tenants.)

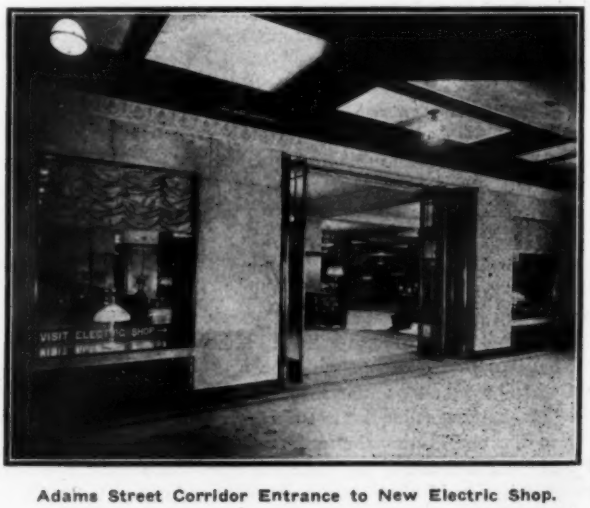
While the new building has been in service since about May 1, the opening week marked the completion of the new electric shop, on the main floor, which is undoubtedly one of the largest and most complete displays of electrical devices in the country. Every appliance known to the industry, from the smallest pocket flashlight to the electric passenger vehicle, is shown here, in surroundings which set each device off to its best advantage.

The electric shop is located on the main or street floor of the building and occupies approximately 11,000 square feet of floor space. It is reached from either the Adams or Clark Street entrances of the building and attractive show windows line the passageway from each entrance. The interior trim is of American walnut and all of the furnishings harmonize with this. Special fixture and lamp-display rooms and a ladies' rest room form a part of the electric shop facilities.

During opening week the attention of the visitors was centered largely on the new service bureau of the company which has recently been inaugurated for the convenience of customers who transact business with the company over the telephone. All telephone calls to the Edison company are received at the company's 20-position private-branch exchange switchboard and unless for an individual are classified into one of three main divisions. All calls for information from connected customers relative to bills, discounts, etc., are immediately transferred to a special switchboard in the accounting department where the requested information can be given without delay. All calls from customers for information regarding rates, cost of appliances, repairs, etc., or orders for material, lamps, appliances, repair work, etc., are transferred to a special switchboard in the service bureau. This board is manned by male operators who are provided with price lists, order blanks, etc., and are in a position to complete a transaction without referring to any other department. The third division is of calls originating from either company salesmen in the field, or applicants, regarding new business. Such calls are transferred to a special switchboard in the contract department where are stationed experienced men who on learning the address of the location where work is to be or is being done can immediately connect over a separate wire with a



Edison Building, Main Entrance at 72 West Adams Street.



Adams Street Corridor Entrance to New Electric Shop.

file clerk having jurisdiction of status reports in the particular district involved. Upon gleaning the information from the file clerk the operator then transmits it to the party calling, the entire transaction taking but a few seconds. The rapidity with which the file clerks can report the status of a job is due to an elaborate follow-up system of reports involving almost every department of the company. This system will be described in greater detail in a subsequent issue.

In the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for June 5, 1915, there appeared a detailed description of the other features of the new Edison Building. The accompanying illustrations are supplementary to those already published but can give only a meager idea of the beauty and spaciousness of the quarters. It is the aim of the company to provide in the new building every means possible to aid its customers to secure the unequivocal fulfillment of its slogan, "Service First."

A View in New Electric Shop in Edison Building.

Another View in Electric Shop.

Information Desk in Central Public Hall of Edison Building.

Private Telephone Exchange of Commonwealth Edison Company.

Service Bureau for Distributing Customers' Telephone Requests to Proper Departments.

Lighting Division of the Contract Department and Some of Its Salesmen.

ADVANTAGES OF STANDARD MOTOR SPEEDS.

By Harry N. Gilbert.

In the beginning of the electrical apparatus business, as in probably all other manufacturinig industries, there was very little in common between the apparatus manufactured by different companies. Sizes of machines were very different for the same outputs, the voltages were different and in alternating-current lines the frequencies were different. Even now there are frequencies of 25, 30, 40, 55, 60 and 133 cycles in use on the North American continent which is far from uniformity. The greater majority of apparatus, however, is for 60 and 25 cycles.

It early became evident that some of these things ought to be standardized and the direct-current voltages 115, 230 and 550, gradually became more predominant. There is now a tendency to make fractional horsepower direct-current motors for 115 volts and larger ones for 230 volts, unless they are to operate on railway circuits when they are wound for 550 volts.

Going over to the mechanical side, things were in a much worse condition. If a five-horsepower direct-current motor of any particular speed was wanted it could almost certainly be found on some manufacturer's list of standard ratings, no matter what the speed was. Since the advent of the alternating-current motor and the almost universal adoption in this country of 60 and 25 cycles, the speeds of direct-current motors have had a tendency to group around the alternating-current motor speeds, such as 1,750, 1,500, 1,150, 850, etc. There is still a great deal of room for improvement, however.

There are many reasons why the manufacturers of motors should standardize on ceratin speeds; some of these reasons are given below:

(First). If certain speeds are standard and the motor-buying public comes to know them there will not be so many calls for odd speeds. This will enable the manufacturers to carry stock motors and stock parts, as not so many will be required to meet demands.

(Second). The consumer will be benefited, as he will be better able to compare prices of motors made by different companies, if quotations are received on motors that are all of the same speed.

(Third). If a manufacturer of a machine designs it for direct connection to an electric motor of a certain speed and, if there are certain standard speeds from which he can choose, he is not limited to one or two manufacturers' motors.

The question of pulley diameters and faces taken in connection with standard motor speeds is a vital one for both the motor manufacturer and the pulley manufacturer. If all motor manufacturers will agree to use certain diameters and faces of pulleys for certain motor ratings, and if they will agree on certain standard lengths and diameters of pulley-end shaft extensions, the pulley manufacturers can reduce their stock of pulley sizes by several thousand. This will result in cheaper pulleys and will help the pulley manufacturers to make better deliveries.

It is interesting to note that there is an organization of motor manufacturers, the Electric Power Club, which has adopted some standardization rules along these lines. When motor manufacturers are able to put these adopted standards into effect matters will be very materially bettered. They have adopted the following ratings, speeds and pulley sizes for direct-current and alternating-current motors:

Horse-power.	Speed R.P.M.	Horse-power.	Speed R.P.M.	Pulley Size, Diam. Face, Inches.
2	1,750	1	1,150	4 by 3
3	1,750	2	1,150	4 by 3
5	1,750	3	1,150	5 by 4
7.5	1,750	5	1,150	6 by 4
10	1,750	7.5	1,150	7 by 5
15	1,750	10	1,150	8 by 6
20	1,750	15	1,150	9 by 7
30	1,750	20	1,150	10 by 8
40	1,700	30	1,150	11 by 10
50	1,700	40	1,150	12 by 11
..	..	50	1,150	13 by 12
..	..	75	1,150	14 by 12
..	..	100	1,150	16 by 13
5	800	..	..	7 by 5
7.5	850	..	..	8 by 6
10	800	..	..	9 by 7
15	850	..	..	10 by 8
20	800	15	600	11 by 10
30	850	20	600	12 by 11
40	800	30	675	13 by 12
50	750	40	600	14 by 12
75	850	50	570	16 by 13

This standardization will assist very materially. When the motor manufacturers adopt and put into effect standard pulley-end shaft extensions, the pulley manufacturers will be benefited. The manufacturers of machinery that is to be belt-driven by electric motors can now do some standardization work which will be of benefit to themselves, to the consumer, and to the motor manufacturer. They should design their machines to use the speeds given in the above table and use pulleys which will permit the use of the above standard pulleys. If this is done, the number of special pulleys needed will be, in time, very much reduced.

Edison Rents Vehicle Batteries on Monthly Charge Basis.

At a private visit of inspection to the Edison laboratory and factories on Monday, September 20, Thomas A. Edison explained his plan to facilitate the use of electric-vehicle delivery equipment. It consists, essentially, in the merchant purchasing his electric delivery vehicle on the installment plan and hiring the battery to run it at a nominal monthly rental.

Representatives of the New York Edison Company, the United Electric Light and Power Company, the Edison Electric Illuminating Company of Brooklyn, the electrical department of the Flatbush Gas Company, the New York & Queens Electric Light and Power Company and the Public Service Electric Company of New Jersey, gave the new plan their hearty endorsement and have promised their cooperation and support to a specific sales campaign proposed by the Ward Motor Vehicle Company.

Charles A. Ward, secretary and treasurer of the vehicle company, told the guests how he was going to make the plan an assured success by offering the "Ward Special," a 750-pound delivery wagon, for $875 on easy monthly payments, with one year's rental of the Edison battery included. This offer will be open only until October 31.

Electrical Supply Jobbers' Quarterly Meeting.

A goodly number of electrical supply jobbers, with as many manufacturers' representatives, attended an interesting three-day session of the Electrical Supply Jobbers' Association of the United States, at the Hotel Clifton, Niagara Falls, Canada, on September 14, 15 and 16. Considerable attention was given during the business sessions to a discussion of the more efficient preparation and distribution of the Association catalog. William Gloeckner, secretary and sales manager of the V. V. Fittings Company, Philadelphia, contributed an interesting feature to the meeting in an address entitled "The Selection of Jobbers as Viewed by the Manufacturer." George W. Hill, representing the Society for Electrical Development, described the propaganda under way in connection with Electrical Prosperity Week.

Jobbing conditions on the Pacific Coast were discussed by H. V. Carter, of the Pacific States Electric Company, San Francisco. The recent decision of Judge Hough, of the United States Circuit Court, in connection with the Cream of Wheat case, and the Stevens Bill were discussed by Thomas M. Debevoise, general counsel of the Association.

The Executive Committee action in voting to hold three meetings in 1916 instead of the usual four, was approved by the general meeting. The next session will probably be held at Hot Springs, Va., early in December, and next year meetings will be held in February, June and October.

A telegram to W. W. Low, president of the Electric Appliance Company, of Chicago, who recently underwent an operation for appendicitis, expressed the gratitude of the Association over Mr. Low's splendid recovery and tendered cordial wishes for his continued improvement in health.

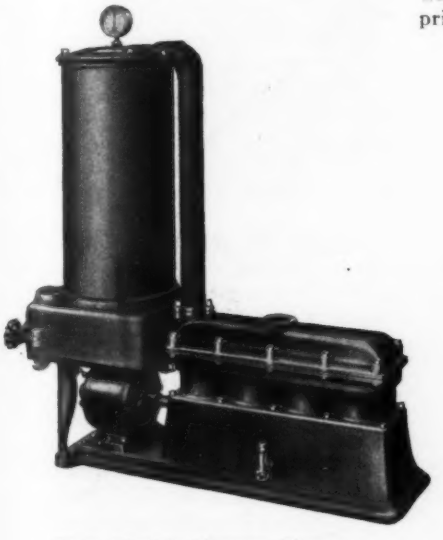
New Electrical and Mechanical Appliances

New Stationary Vacuum Cleaner.

The new vacuum cleaner illustrated herewith is made exclusively for residence service by the Palm Vacuum Cleaner Company, Detroit, Mich. Instead of the rotating fan commonly used to provide the vacuum, this outfit is equipped with a four-cylinder vertical-plunger vacuum pump which is direct-connected to the motor. On a closed system the pump will show a vacuum of seven inches of mercury, and the air displacement at the end of the hose is 50 cubic feet per minute.

The outfit is equipped with an automatic lubricating system and needs attention but once or twice yearly. It has a collapsible self-cleaning bag and removable dust pan. The set is very compact and all moving parts are inclosed. One pipe connection only is required, and it is not necessary to bolt the machine to the floor.

This cleaner is equipped with a one-half horsepower direct or alternating-current motor, made by the Robbins & Myers Company, Springfield, O.



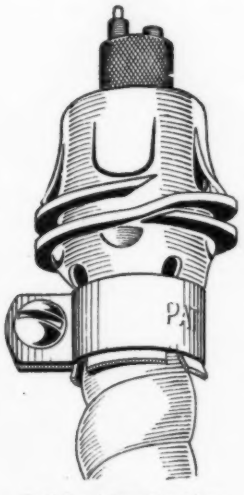
Palm Electric Vacuum Cleaner.

Snap Self-Locking Bushing for Armored Conduit or Cable.

In wiring with flexible steel-armored conduit or cable, which is becoming more and more general, a serious problem presents itself in making secure connection between the cable sheath and the outlet boxes or plates. This connection must be reliable not only mechanically, but also electrically, which necessitates that there be provided a bushing which at the same time will serve to clamp the sheath securely.

A very simple and unique type of bushing for accomplishing this is being placed on the market by the Self Locking Bushing Company, whose headquarters are in the Washington Loan & Trust Building, Washington, D. C. This bushing is appropriately called the "Snap"; to put the bushing in place requires merely a push and snap and the entire operation is really a "snap" in the common slang use of the term. The illustration gives a fair idea of the principle of this device. The bushing has punched spring leaves which, after it has been pushed into the knockout, hold it in place so it cannot slip backwards. A strong pressed-steel spring surrounding the body of the bushing acts as a buffer between the outer surface of the outlet box and the supporting shoulders of the bushing. The strong compression of this spring makes a secure and permanent contact between the bushing and box which no jarring or shaking can dislodge. The armor of the cable is grasped by the clamp, which fits around the extended split sleeve of the device. In tests this device was subjected to a pull of over 200 pounds between the cable and box without any loosening or disturbance to either box or cable.

The entire device is galvanized and comes complete without loose parts. Its cost is no higher than that of similar devices and its installation is the work of but a moment, since it is necessary merely to clamp the device to the end of the armor and push it in place in the knockout. Electricians and contractors who have seen the device have expressed pleasure at its simplicity and convenience.



Self-Locking Bushing.

New Hubbell Shade-Holder.

To meet the increasing demand for spring locking shade-holders there has been placed on the market by the firm of Harvey Hubbell, Incorporated, Bridgeport, Conn., a new type of locking spring holder of the 2.25-inch size. The operating wings on this holder are set vertically, thus providing a more convenient grip. The slots from which these operating wings protrude are cut eccentric, thus eliminating practically all friction as the spring wires pass each other, and also greatly prolonging the life of the holder. To minimize the possibility of unintentional release, it is necessary to force both wings to the center before the shade or reflector can be withdrawn.

This new holder can readily be attached to any standard brass-shell socket by means of the Hubbell contractile collar. This distinctive method of attaching assures an absolutely rigid unit and eliminates any possibility of the holder working loose from the socket. Upon insertion of the shade or reflector it is automatically centered by the spring wire and this insures obtaining the maximum efficiency of the unit by having the reflector always in proper position.

New Shade-Holder.

New Horton Electric Washer.

Ever since the year 1871 the Horton Manufacturing Company, Fort Wayne, Ind., has been studying the problem of making every possible improvement in washing machines. The result of this effort has been the production of a new Horton electric washer, with the

new three-way-wringer feature, which the company is now offering to the trade.

This machine also embodies all the important features that have made Horton machines so well and favorably known in the past. Driving gears are all machine-cut, reducing noise and friction to a minimum. The five-year roll, reversible, ball-bearing wringer is equipped with a patented automatic safety device to prevent injury. All gears are covered. The dolly is guarded so clothes cannot tear. The motor is a special Fort Wayne make of ample power to operate the washer and wringer at the same time. A hand operating attachment eliminates the possibility of the machine or wringer being put out of commission in case of temporary

New Horton Washer.

power trouble. A simple movement of the hand swings the wringer from one position to another over any make of stationary tubs.

All Horton dealers are liberally supplied with high-class advertising matter, and sales helps of every description. The factory maintains a department for this purpose exclusively.

Benjamin Outlet-Box Fittings and Fixtures.

For some time there has existed a demand for a system providing for reflector and fixture changes without disturbing the interior wiring. To meet this need there has been placed on the market by the Benjamin Electric Manufacturing Company, 128 South Sangamon Street, Chicago, Ill., a line of special outlet-box fittings and fixtures. The outlet-box fittings consist of an

Outlet-Box Fitting for Deep Boxes.

appropriate lamp receptacle interior inclosed by a finished brass cover, in several sizes and designs, and provided with means for attachment to the outlet box. The cover terminates in a threaded portion adapted to receive a

Outlet-Box Fitting for Shallow Boxes.

variety of threaded holders and threaded metal reflectors, as well as certain connecting devices, which facilitate fixture installation and interchange.

In the creation of these appliances the Benjamin company found it possible to construct the base fittings, so

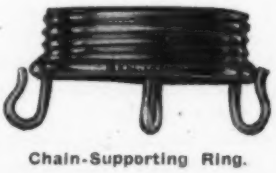
Ceiling Fixture.

that once installed they would be established as permanent parts of the interior wiring system. They preclude the necessity of deranging the wiring when new lighting demands arise, because of the provision made for making changes through the threaded counterparts on fittings, holders, re-

Fixture Connector.

flectors and connecting pieces. Thus a succession or exchange of fixture types is made possible without the necessity of disturbing the wiring connections. Once in place, the base fittings remain indefinitely, while accessories are changed at will.

Should, at any time after the original



Chain-Supporting Ring.

ceiling-type fixture installation, it be deemed advisable to substitute for this a stem fixture, that change is made possible through the use of the Benjamin fixture connector. This device is a mechanical and electrical coupling. Attached to a fixture, the latter becomes a complete wired lighting unit ready for attachment to the outlet-box fitting. A few turns of the thread, at a minimum expense for labor, installs the fixture.

The Benjamin chain-supporting ring performs a similar office in connection with fixtures having chain suspensions. The threaded ring is readily attached to any Benjamin threaded socket, as well as to the fittings and fixtures illustrated herewith.

An Electric Hot-Water Radiator.

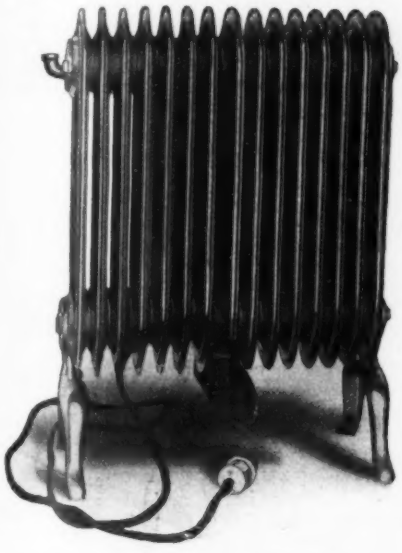
The use of electricity for heating rooms is gradually increasing, especially in those parts of the country where comparatively cheap rates are obtainable. Practically all such electric heating is done by means of various luminous or non-luminous radiators or air warmers; in all such cases the heat generated by the current passing through the resistance elements is utilized directly. Such radiators or heaters are efficient and satisfactory, but do not possess any great heat storage; consequently, as soon as the current is switched off, the radiator rapidly cools.

A new type of electric radiator in which this last disadvantage is overcome has been placed on the market by the Rathbone Manufacturing Company, Grand Rapids, Mich. This appliance is a combination electric and hot-water radiator and is illustrated herewith. The outfit resembles very closely a hot-water radiator of the standard type, except that the coils are somewhat more slim. This radiator is an entirely self-contained semi-portable unit. In the lower portion is an electric heating element, which is connected by a substantial flexible cord to the circuit. In the case of the smaller radiators, such as the one shown, it can be connected to an ordinary lighting socket, since the maximum load is only 660 watts. When the current is turned on a very effective circulation of hot water is obtained through all of the coils of the radiator. As soon as the water has attained the degree of heat desired, the current can be reduced to an amount sufficient to maintain the hot water at that temperature.

In the radiator shown there are 15 coil sections with a total heating surface of 22.5 square feet. This large radiating surface produces a very effective means for heating small or moderate-sized rooms. Such a radiator can be used for heating a room with a volume of about 1,000 cubic feet to a

temperature of 70 degrees Fahrenheit. A larger-size radiator is also made, which has 21 sections and takes 990 watts at full heat and 660 at low heat; this larger size has a radiating surface of 31.5 square feet; on account of its exceeding the circuit limitations, it must be connected to a special outlet. Its heating capacity is proportionately greater than that of the size illustrated.

The sections of the radiator are made of steel carefully assembled and neatly finished. The radiator requires one filling of water before being put in service and an occasional addition of a small amount to make up for any evaporation. The total weight of the smaller radiator when full is 65 pounds. It is provided with polished smooth feet so that it can be readily pushed about on a tile or other smooth floor without lifting. In operation no pressure is developed, nor is there any liability for the production of steam. The heating elements are of such rating as to insure operation of the appliance as a hot-water radiator. Ample provision is made for evaporation and for expansion of the water when heated.



Rathbone Electric Hot-Water Radiator.

Among places where it is particularly suitable are buildings or rooms not equipped with a permanent heating system and in rooms where extra heat is desired for either temporary or permanent use. It can also be used in stores where any other form of fuel, gas or steam heating would cause damage to stocks of delicate goods.

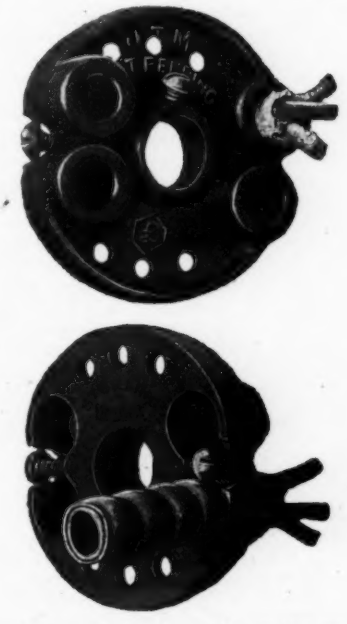
Many advantages are possessed by this appliance. It is absolutely safe, since no flame or very-high-temperature surface is present; the liability of children burning themselves on a very hot surface is eliminated. It does not consume oxygen of the air, nor give off gaseous products, but is entirely odorless and, of course, free from smoke, soot and ashes. It is very readily installed and can be placed wherever desired to give its heat effectively. Probably the most important advantage of this device is in its heat-storage capacity. If it is desired to operate on an off-peak plan, to get the advantage of special off-peak rates, the radiator can be kept connected at low heat and entirely disconnected during the period of peak load. The heat stored in the radiator will keep it warm for a long time. Again, if it is desired to utilize the house circuits without exceeding a definite maximum demand or allowed capacity, the radiator may be kept connected until other load is to be used, when it may be temporarily disconnected without immediately losing all of its heat-giving property; thus, the radiator may be disconnected during the time that electric cooking, ironing or much lighting throws a heavy load on the house circuits. Use of this radiator, therefore, should greatly improve the load-factor of residence service.

Sterling Outlet Plate and Connector for Armored Cables.

The increasing use of flexible steel-armored cable and conduit is bringing about a greater need for reliable means for clamping the armor of the cable to outlet plates and to conduit boxes. In this line there have recently been placed on the market two devices to meet these requirements. The first of these is known as the Sterling Biplex outlet plate. The device is very simple in construction. The distinctive feature is that it has an adjustable set-screw that clamps the cable armor securely in place, thus it can be very quickly applied, and when the screw is tightened properly it has a secure grip on the corrugated outer surface of the armor. Use of this device thus entirely eliminates the need of clamps. It can be used for either one or two cable ends. This outlet plate is given an electro-galvanized finish to prevent rusting. The illustrations herewith show the simplicity of the entire device, and the absence of loose pieces for clamping, which avoids the difficulty usually met in entering the cable in the outlet plate. The device is made for either straight electric or combination gas and electric outlets. The combination plate is made to fit on drop elbows without reaming.

Outlet-Box Bushing and Connector for Armored Cable.

The new armored-cable connector is known as the Hexcel Connector, and is built for use with standard outlet boxes with knockouts for one-half-inch conduit. It is of simple construction, consisting of a cast-iron sleeve or bushing with thread and locknut for attaching to the box and a clamping screw for securing the cable in place. This device is made with electro-galvanized finish. It can be very easily and quickly applied and securely grips the cable in place. These devices are manufactured by the Sterling Foundry & Machine Company, Newark, N. J.



Two Views of Sterling Biplex Outlet Plate.

Frantz-Premier Spreads Out.

The Frantz-Premier Company, of Cleveland, O., heretofore known only as a vacuum cleaner manufacturer, is about to place on the market a comprehensive line of electrically-operated household utensils, including washing machines, wringers (which will be sold separate from the washing machines as well as in conjunction therewith), dish-washing machines, and an exceedingly unique electric fan for household and office use.

The new factory at Ivanhoe Road and Euclid Avenue, Cleveland, providing greatly increased accommodations, is nearing completion. This new factory will be of four stories, built of concrete and fitted with every modern convenience and equipment. The company expects to move from its present quarters in the Whitney Power Block to the new building about November 1.

Among recent enterprises undertaken in Spain by foreign capital is the hydroelectric development of Catalonian water powers for the benefit of Barcelona and vicinity.

Current Electrical News

ATLANTIC STATES.

CAMDEN, N. J.—A three-story brick and concrete addition to the plant of the Taylor-White Extracting Company will be erected here. Ballinger & Perrot, Philadelphia, are the architects.

WILMINGTON, DEL.—The William Freihofer Baking Company will erect a large baking plant, stable and power plant here to be constructed of concrete and steel, brick and stone. Peucket & Wunder, 310 Chestnut street, Philadelphia, Pa., are the architects.

ALLENTOWN, PA.—A six story addition to the Young Men's Christian Association building will shortly be constructed here. The total cost will be about $140,000. Louis E. Jallade, 37 Liberty street, New York City, is the architect.

PHILADELPHIA, PA.—A $350,000 10-story concrete and steel office building will be erected for William L. McLean here. E. V. Seeley is the architect.

PHILADELPHIA, PA.—The United Electric Construction Company of this city has been awarded the contract for the electrical equipment of the six-story building to be erected at Eleventh and Race streets, here. Ballinger & Perrot, Philadelphia, are the architects.

SCRANTON, PA.—Contracts for the erection of three new buildings to cost $300,000 at the State Hospital for the Criminal Insane, at Fairview, Wayne county, have been awarded as follows: General contract to P. J. Hurley, Bayside, L. I.; heating, ventilating and plumbing to Faith Company, Philadelphia, Pa.; electrical construction to Francis Buchanan, Philadelphia, Pa.

COLUMBUS, GA.—A municipal lighting plant may be installed. Address mayor.

GREER, S. C.—Bonds amounting to $18,000 have been voted for a municipal electric light plant. Address mayor.

NORTH CENTRAL STATES.

BELLEFONTAINE, O.—A $10,000 light system may be installed by the City Council. Address W. T. Haviland.

ELYRIA, O.—The Lorain County engineer is preparing plans for a city municipal light plant. Address city clerk.

BONDVILLE, ILL.—Plans are under way here for the organization of an electric light company to provide a lighting system for the town. Z.

LERNA, ILL.—The Council is planning ways and means to secure electric lighting. Address village clerk.

NORMAL, ILL.—Members of the Business Men's Association plan the installation of cluster lights on a number of streets. Z.

SPRINGFIELD, ILL.—Bids will be received by the State Board of Administration until 3 p. m. October 18, for wiring of four new buildings to be erected on the site of the State Colony for Epileptics near Dixon, Ill. The buildings are a power house, a laundry, a cold storage building and a bakery. Plans and specifications are on file at the office of the state architect, J. B. Dibelka, 130 North Fifth Avenue, Chicago. Z.

STREATOR, ILL.—A resolution has been passed by the Board of Local Improvements providing for the installation of a boulevard lighting system on two streets. One is to be on Main Street from Water to Illinois Street and the other on Vermillion Street from Hickory to Bridge Street.

WEST SALEM, ILL.—The City Council has voted to grant a franchise to the West Sales Light & Ice Company. It is planned to erect a light plant at West Salem.

HAUGEN, WIS.—The Wisconsin-Minnesota Light & Power Company has obtained a franchise from the town board to install and operate a light and power plant at Haugen. The company, which has a dam on Bear Creek at this place, has commenced rebuilding and enlarging the same, and will put in a large and modern electric light and power plant and have the same in operation within a few months, when the village will be wired for electric lights. The Haugen Commercial Club is in communication with some industrial plants who are looking for new locations, where they can secure cheap power, and it is expected they will get some of these factories located at Haugen within the coming year.

MILWAUKEE, WIS.—It is reported that John I. Beggs and associated capitalists have obtained possession of the Southern Wisconsin Power Company, representing an investment of $2,500,000.

KEOKUK, IOWA.—The Keokuk Electric Metals Company will erect a plant to cost about $90,000. Address G. E. Weissenberger, president.

KEOKUK, IOWA.—The Johnson Smelting Company (Electric) will erect a plant for electric smelting of ores; estimated cost $75,000. Address Byron E. Eldred, president.

MARATHON, IOWA.—The town has voted bonds to the amount of $12,000 for the construction of a municipal electric lighting plant.

HUNTER, N. D.—The Hunter Light & Power Company plans to purchase, within the next year, an engine-driven generating unit, pumping equipment, switchboard, conduit, meters and various equipments for street-lighting system; company also plans to purchase within two months 10 washing machines, two dozen heating and cooking devices, and a number of wiring supplies. Address R. D. Hockridge, secretary and general manager.

TOWER, N. D.—The Council is considering plans for an electric light plant. Address city clerk.

DUBOIS, NEB.—Bonds have been voted for electric lighting. A transmission line is to be built from the Pawnee City plant. Address town clerk.

CENTRALIA, KAN.—A transmission line will be built to Goff, which has just voted, at a bond election, for a lighting system.

SOUTH CENTRAL STATES.

DECATUR, ALA.—The Alabama Power Company will build a transmission line from Decatur to Hartselle. The company recently bought the electric light plant at Hartselle, where at present only night service is available. With the completion of the transmission line day and night service will be offered.

BARTLETT, TEX.—The Texas Light and Power Company will extend its long-distance transmission system to this place and provide the town with light and power. D.

CORSICANA, TEX.—The Corsicana Electric Light and Power Company has been organized here. Capital, $1,000. Incorporators: F. N. Drane, J. W. Carpenter and S. M. Kerr. D.

LULING, TEX.—The Luling Electric Light and Power Company plans to install a street-lighting system here.

MEXIA, TEX.—The Central Texas Ice Company has changed its name to the Central Texas Ice, Light, Power and Water Company and increased its capital stock from $60,000 to $100,000. D.

WESTERN STATES.

ANACONDA, MONT.—Electric lights will be placed in the city parks. Address city engineer.

GREAT FALLS, MONT.—W. H. Harrison, city clerk, reports that the City Council has passed a resolution of intention to create a special improvement district for the installation of a street-lighting system. Council proposes to erect and construct 10 lamp posts in each block, with one 100-candle-power lamp upon each post, and two lamps of like candlepower in the alleys of each block embraced in the district. Cost estimated at $8,280. The final resolution will be passed at the Council meeting September 28. O.

PHOENIX, ARIZ.—The Board of Supervisors has granted the application of L. G. Wilson for a franchise to build light and power lines connecting the townsite of Gilbert and adjoining lands with the government line to Sacaton.

TUCSON, ARIZ.—City Manager C. K. Clarke has recommended to the City Council an improvement bond issue of $100,000, the sum of $50,374 to be used to complete the ornamental lighting system.

CHEHALIS, WASH.—The sale of the property of the Washington-Oregon Corporation has again been announced for October 16, at the courthouse in this city. This sale was to have been held July 3, but was postponed on account of the Centralia city commission accepting a contract from H. G. Fleischhauer, which action annulled that city's contract with the Washington-Oregon Corporation. O.

COLFAX, WASH.—The Steptoe Light and Power Company recently incorporated by E. M. Woodin, of Colfax, and Ollie Cooper and Maude Cooper of Steptoe, has been granted a franchise for 50 years by the county commissioners of Whitman County to construct, operate and maintain power transmission lines for light and power in Steptoe, an unincorporated town 12 miles north of Colfax. It is reported the company will make immediate installations and connections. O.

ELLENSBURG, WASH.—Reported the City Council has passed a resolution awarding the contract for the lighting plant to Kraner Construction Company, of Portland, Ore., work to start after election of September 23, to legalize $60,000 bond issue. O.

SEATTLE, WASH.—The Commissioners of King County have granted the Puget Sound Traction, Light & Power Company a light and power franchise extending over the entire southern portion of the county.

SEATTLE, WASH.—The School Board has decided to install an electric heating plant in a portable school at the Walla Walla school building as an experiment without cost to the district. This will be the first electrically heated school building in the city. O.

BAKER, ORE.—It is reported the W. H. Eccles Lumber Company, here, whose plant recently sustained a $100.-000 loss by fire, and which is being rebuilt, will install electric motors for the large woodworking machines in the plant, until arrangements necessary for installing steam power can be made. The company is in the market for motors and electrical equipment, according to reports. O.

PILOT ROCK, ORE.—J. B. Sparks and L. L. Harland, of Heppner, Ore., have submitted a proposition to local business men for installing an electric light system here.

LOS ANGELES, CAL.—The City Council has prepared an ordinance providing for the ornamental lighting of Hobart Boulevard between Washington and Sixteenth Streets.

MANHATTAN BEACH, CAL.—A resolution has been adopted by the city trustees ordering lighting posts on Fourteenth and Fifteenth Streets maintained and electric current furnished for two years.

PASADENA, CAL.—At an election on October 16 a bond issue in the sum of $25,000 will be voted upon for ornamental lights, extending over an area of 18 miles at Lamanda Park.

RED BLUFF, CAL.—The Board of Trustees is considering plans for a cheaper lighting system, either by purchasing the present system or by installing a new system.

TROPICO, CAL.—The City Engineer has been instructed to prepare plans and specifications for lighting San Fernando Boulevard from Brand Boulevard to Tropico Avenue.

PROPOSALS.

LIGHTING FIXTURES.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until October 27, for lighting fixtures for the United States postoffice at Monongahela, Pa. Drawings and specifications may be obtained from the custodian of site at Monongahela, or at the office of the Supervising Architect, Washington, D. C.

NAVY ELECTRICAL SUPPLIES.—The Bureau of Supplies and Accounts, United States Navy Department, Washington, D. C., will receive bids on October 5 for the following material, delivery to be made at the Brooklyn Navy Yard. Intending bidders should write for the schedule numbers mentioned: 22 alternating-current, 110-volt, 60-cycle fans; miscellaneous rubber-covered, solid, single wire; 35,000 feet duplex lighting and power wire; 45,000 feet ship-lighting cable, schedule No. 8800; miscellaneous intercommunication cable; 57,200 feet galvanized steel conduit; miscellaneous telephone cable; 6,500 feet plain, single-conductor wire; 10,000 feet double-conductor wire; miscellaneous plain, twin-conductor wire; miscellaneous leaded and armored twin-conductor wire, schedule No. 8801.

NEW INCORPORATIONS.

JEFFERSON CITY, MO.—The Campbell Electric Light & Power Plant has been incorporated with a capital of $30,000, by R. C. Jones and others.

IOWA FALLS, IOWA.—The Commonwealth Light & Power Company has been incorporated with a capital of $250,000. Frank Tichenor is president.

BROOKLYN, N. Y.—United Battery Corporation; to manufacture batteries and other electrical supplies. Capital, $100,000. Incorporators: David Burr Luckey, A. M. Sullivan and A. E. Moloney.

WRIGHTSVILLE, S. C.—The Warren Electric Company has been commissioned, with a capital stock of $10,000, to build and operate electric light plants and telephone exchanges, and to handle electric and telephone supplies. Address W. M. Warren.

DOVER, DEL.—The Middle Georgia Power Company, with a capitalization of $700,000, has been incorporated by Herbert E. Latter and William J. Maloney, of Wilmington, and Clement M. Egner, of Elkton, to manufacture and distribute electric current for light, heat and power.

FINANCIAL NOTES.

Westinghouse Electric & Manufacturing Company will redeem on January 1, next, the old convertible five per cent bonds at 105 and interest. Holders desiring to anticipate this debt of redemption may surrender their bonds after September 16, receiving 105 and interest from July 1, last, to date of surrender. Bonds may be presented at the Guaranty Trust Company, New York City, for redemption.

At a meeting of managers of the various gas and electric properties operated by H. M. Byllesby & Company, J. J. O'Brien, vice-president and treasurer, stated that the success of the refinancing plan for Standard Gas & Electric Company by the sale of $3,750,000 six-per-cent 20-year debentures to stockholders of the company is already assured. In case the refinancing plan is successfully carried out, cash dividends on the eight-per-cent preferred stock of Standard Gas & Electric will be resumed at the rate of one per cent quarterly beginning with the new year.

Dividends.

	Term	Rate	Payable
Am. Pr. & Lt., pf	Q	1.5 %	Oct. 1
Am. Pub. Util., pf	Q	1.5 %	Oct. 1
Bangor Ry. & Elec., pf.	Q	1.75%	Oct. 1
Buffalo Gen. Elec.	Q	1.5 %	Sept. 30
Cin. & Sub. Bell Tel.	Q	2.5 %	Oct. 1
Cin., H. & D. Trac.	Q	1 %	Oct. 1
Cin., H. & D. Trac., pf.	Q	1.25%	Oct. 1
Col. Ry., Pr. & Lt., prior pref.	Q	1 %	Oct. 1
Col. Ry., Pr. & Lt., Ser. A pf.	Q	1.5 %	Oct. 1
Consumers' Pr. of Mich., pf.	Q	1.5 %	Oct. 1
Duquesne Lt., pf.	Q	1.75%	Nov. 1
Duluth Edison, pf.	Q	1.5 %	Oct. 1
Elec. Stor. Battery	Q	1 %	Oct. 1
National Carbon, pf.	Q	1.75%	Nov. 15
National Carbon, com.	Q	1.5 %	Oct. 15
New Orleans Ry. & Lt., pf.	Q	1.25%	Sept. 30
N. Y. State Rys.	Q	1 %	Oct. 1
N. Y. State Rys., pf.	Q	1.25%	Oct. 1
Ohio State Tel., pf.	Q	1.75%	Oct. 1
Ottawa Lt., Ht. & Pr.	Q	1.5 %	Oct. 1
Penn. Water & Pr.	Q	1 %	Oct. 1
Phila. Co.	Q	1.5 %	Nov. 1
Phila. Co., pf.	S	3 %	Nov. 1
Rep. Ry. & Lt., pf.	Q	1.5 %	Oct. 15
Shawin W. Pr.	Q	1.5 %	Oct. 9
Toronto Rys.	Q	2 %	Oct. 1
United Utilities, pf.	Q	1.75%	Oct. 1
United Lt. & Rys., first pf.	Q	1.5 %	Oct. 1
Wash. Water Pr.	Q	1.25%	Oct. 1
West India Elec.	Q	1.25%	Oct. 1
Western Ohio Ry., first pf.	Q	1.75%	Oct. 1

Reports of Earnings.

NEW ENGLAND COMPANY POWER SYSTEM.

	1915	1914
August gross	$119,829	$ 71,881
Net after taxes	77,805	41,226
Surplus after charges	30,831	12,034
Balance after preferred dividends	3,785	*8,516
Eight months' gross	909,908	648,807
Net after taxes	573,508	397,647
Bond interest	269,455	221,747
Other interest	46,781	13,994
Surplus	257,272	161,906
Preferred dividends	203,408	164,400
Balance	53,864	*2,494

*Deficit.

For August, 1915, earnings and expenses of Bellows Falls Power Company are included, but not for August, 1914. Eight months' statement included earnings and expenses of Bellows Falls Power for five months in 1915, but not for the eight months of 1914.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Sept. 20	Sept. 13
American Tel. & Tel. (New York)	123½	122¾
Commonwealth Edison (Chicago)	136	136
Edison Electric Illuminating (Boston)	—	237
Electric Storage Battery common (Philadelphia)	74	72½
Electric Storage Battery preferred (Philadelphia)	74	72½
General Electric (New York)	171½	170⅛
Kings County Electric (New York)	120	120
Massachusetts Electric common (Boston)	8	8
Massachusetts Electric preferred (Boston)	43¼	43
National Carbon common (Chicago)	140½	140½
National Carbon preferred (Chicago)	120¾	120
New England Telephone (Boston)	131	129½
Philadelphia Electric (Philadelphia)	25	25
Postal Telegraph and Cables common (New York)	75¼	76
Postal Telegraph and Cables preferred (New York)	66½	66½
Western Union (New York)	76½	75¾
Westinghouse common (New York)	118¾	114
Westinghouse preferred (New York)	131	134

INTERSTATE ELECTRIC CORPORATION.

	1915	1914
July gross	$ 32,177	$ 29,672
Operating expenses	18,236	17,187
Net earnings	13,941	12,435
12 months' gross	356,755	321,835
Operating expenses	212,764	194,716
Net earnings	143,990	127,119

UNITED STATES PUBLIC SERVICE.

	1915	1914
July gross	$ 68,051	$ 65,539
Net after taxes	25,416	25,467
Balance after bond interest	18,497	19,082
Surplus after note interest	12,497	13,082
12 months' gross	883,085	791,616
Net after taxes	365,164	287,761
Balance after bond interest	285,376	225,626
Surplus after note interest	213,376	153,626

SHERBROOKE RAILWAY & POWER.

Comparative report for the year ended June 30:

	1915	1914
Gross earnings	$146,769	$141,990
Net after taxes	55,920	54,020
Surplus after charges	24	*2,059

*Deficit.

AMERICAN RAILWAYS COMPANY.

Subsidiaries of American Railways Company report consolidated gross earnings as follows:

	1915	1914
August gross	$ 472,614	$ 504,253
Eight months' gross	3,536,524	3,700,227

NEVADA-CALIFORNIA POWER COMPANY.
(And Subsidiaries.)

	1915	1914
July gross	$142,591	$139,783
Net after taxes	74,285	71,625
Surplus after charges	41,956	44,502
Balance after sinking fund	37,347	39,999
Seven months' gross	945,172	851,640
Net after taxes	478,670	396,747
Surplus after charges	249,864	202,823
Balance after sinking fund	219,758	159,496

KEYSTONE TELEPHONE.
(Combined Companies.)

	1915	1914
August gross	$114,330	$112,546
Net	57,184	58,938
Surplus	30,316	32,901
Eight months' gross	899,154	880,262
Net	451,962	446,810
Surplus	239,490	238,957

PERSONAL MENTION.

MR. C. H. MASON has been appointed manager of the Dansville, N. Y., gas and electric light plant, succeeding Mr. C. G. McAvoy. The latter has been appointed superintendent of the Hornell Electric Company.

MR. W. M. TURNLEY announces his resignation as sales manager of the Northern Electric Company, of Montreal, Canada, to become manager of the Canadian Carbon Company, Limited, Toronto, Canada, manufacturers of dry cells, flashlights and other electrical specialties.

MR. ROY L. ROHRBAUGH, chief meter inspector and tester of the Sandusky (Ohio) Gas & Electric Company, has returned to his duties after a week's visit to the Fort Wayne Electric Works at Fort Wayne, Ind., where he went to study the construction and operation of the Fort Wayne meters. Mr. Rohrbaugh's work at Sandusky has attracted wide attention because of the ingenuity he has shown in making accurate tests and adjustments without the aid of much of the apparatus found in most of the larger central stations.

MR. WILLIAM E. KEILY, recently associate editor of the *Electrical World*, has opened an office in the Edison Building, 72 West Adams Street, Chicago. For nearly a year past, Mr. Keily has been engaged in literary and consulting work having to do with public-utility problems and relations, and he will continue work of this character, with improved facilities, in his new office. An experienced writing-man, Mr. Keily has done journalistc work in both daily-newspaper and technical-magazine fields. For a number of years he was managing editor of the old *Western Electrician* of Chicago, and thereafter he became associate editor (in Chicago) for the *Electrical World*. Mr. Keily has been familiar with electrical and public utility development in Chicago, and indeed throughout the country, during the last 20 years. For the years 1910-1914 he was editor of the *Convention Daily*, published at the annual conventions of the National Electric Light Association, held in St. Louis, New York, Seattle, Chicago and Philadelphia. Mr. Keily is an associate of the American Institute of Electrical Engineers, a Class B member of the National Electric Light Association,

William E. Keily.

and a member of the Jovian Order, Electric Club-Jovian League of Chicago, National Geographic Society and the City Club of Chicago. Undoubtedly one of the most popular members of the electrical fraternity in the Middle West, with a splendid reputation for good judgment and uprightness of character, Mr. Keily will enjoy the confidence and esteem of an ever increasing clientele.

MR. WALTER SCOTT WYMAN, the president-elect of the New England Section, National Electric Light Association, though named after the great Scottish novelist, has less of the historical romancer than of the up-to-the-minute business organizer and pusher about him. He is of the type of Americans who are for progress, first, last, and all the time. Recently he was appointed a member of the Boost Maine Committee, which has done much to place the agricultural and industrial advantages of that state before the people of the country. Mr. Wyman is no mere boomer, however. He has accomplished things. From the day he left college in '96 he has been actively connected with the electrical industry. Maine is far famed for its universal application of water in preference to liquids with more recoil to them. Some of the natural fluid, apart from that imbibed, goes to waste, but much has been pressed into useful service under the skillful hands of Mr. Wyman and his associates and made to produce the mysterious but powerful electrical "fluid" which is shipped by Mr. Wyman's company in the original package all over the central part of the commonwealth, lighting prosperous cities and pleasant villages, turning a myriad of spindles, lathes and street-car wheels, doing the farmers' chores, in fact, there is nothing, except rocking the summer visitors' hammocks, that Central Maine power doesn't do. Mr. Wyman has just turned 41. His birthplace was Oakland, Maine. His alma maters were, successively, the schools of his native town, the Coburn Classical Institute at Waterville, and Tufts College in Massachusetts, where he took the electrical engineering course. For three years after leaving college he was assistant superintendent of the Maine Water Company, going in 1899 to the general managership of the Waterville & Fairfield Railway & Light Company, which did double duty, as a lighting company and a common carrier. Two years later, with Harvey D. Eaton, of Waterville, Mr. Wyman organized the Messalouskee Electric Company, and furnished current to Waterville and Oakland. In 1907 the Fort Halifax Power Company was organized to transmute running water to running trolley cars between the city which boasts the fame of James G. Blaine, and the busy industrial center which is renowned for Bates' cotton fabrics. In 1909-10 a half-dozen hydro companies (giving new meaning to the expression "hydro-headed") consolidated as the Central Maine Power Company, with W. S. Wyman as general manager and treasurer, which he has been ever since. The company has 15,000 horsepower harnessed, and vast undeveloped horsepower in reserve for use as the power market develops. There are about 100,000 people in the region served, who work, eat and thrive by the power derived from the score of water-power plants on the Kennebec and its confluents. Just at present Mr. Wyman is trying to induce the Maine housewives to discard the old wood stove and to make their pumpkin pies on electric ranges fed from the roof, instead of out of the woodbox. The small boys who were expected to keep the aforesaid woodboxes full, now look upon Wyman as their hero. Aside from his N. E. L. A. membership, Mr. Wyman is also a member of the American Institute of Electrical Engineers, the New England Street Railway Association and the Augusta Board of Trade.

OBITUARY.

MR. FRANK EDWARD JOHNSON, who for the past 10 years has been Instructor in Electrical Engineering at the University of Washington, Seattle, died at Minor Hospital, that city, recently, following an operation for a complication of diseases. The deceased was 41 years of age. He was born at St. Peter, Minn., and was a graduate of the University of Minnesota. In early life, Mr. Johnson devoted his time to public school work in his native state, later affiliating himself with the electrical industry in Minnesota, Wisconsin, Nebraska and Wyoming. At the time of his appointment to the University of Washington, he was superintendent of the Douglas Electric Light Company of Douglas, Wyo.

DATES AHEAD.

American Electric Railway Association. Annual convention, San Francisco, Cal., October 4-8. Secretary, E. B. Burritt, 8 West Fortieth Street, New York, N. Y.

New York Electrical Show. Ninth annual exposition, Grand Central Palace, New York City, October 6-16. George F. Parker, vice-president, 124 West Forty-second Street, New York City.

Empire State Gas and Electric Association. Annual meeting, Engineering Societies Building, New York City, October 7-8. Secretary, C. H. B. Chapin, 29 West Thirty-ninth Street, New York, N. Y.

Jovian Order. Thirteenth annual convention, Hotel Sherman, Chicago, Ill., October 13-15. Mercury, Ell. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

Electric Vehicle Association of America. Annual convention, Cleveland, O., October 18-19. Executive secretary, A. J. Marshall, 29 West Thirty-ninth Street, New York, N. Y.

Association of Railway Electrical Engineers. Annual convention, Hotel LaSalle, Chicago, Ill., October 18-22. Secretary, J. A. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill.

With the Electrical Manufacturers

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is opening up a new district office at Springfield, Mo. Jack Fieber, now of the St. Louis office, will be in charge.

The Solderall Company, New York, announces the appointment of P. Vath, Auditorium Building, Chicago, as its western representative. From now on shipments will be made from Chicago as well as New York.

Philadelphia Storage Battery Company, Philadelphia, Pa., announces that on October 1 its Chicago office will be moved to larger quarters at 1621 South Michigan Boulevard, Chicago, Ill. This branch includes a battery service station.

Cooper Hewitt Electric Company, Eighth and Grand Streets, Hoboken, N. J., has issued bulletin No. 61 describing its M-shaped photographic lamps. These lamps were recently described in our columns and are meeting with much satisfaction in the photographic business.

The Hamilton-Beach Manufacturing Company, Racine, Wis., has put a campaign of national advertising behind its jobber-dealer distribution of "Sew-E-Z" sewing-machine motors and "New-Life" vibrators. Jobbers are invited to write for full details. Dealers are requested to write to their jobbers for information.

The Chelten Electric Company, Philadelphia, Pa., announces the appointment of Walter C. Rardin, 514 West Washington Boulevard, Chicago, as its representative in that city and immediate territory. Mr. Rardin has on hand a full line of consigned stock, literature, discount sheets, and is in a position to give business in this territory his attention.

The Robbins & Myers Company, Springfield, O., has been awarded the grand prize for its very attractive exhibit at the Panama-California Exposition, San Diego, Cal. This company was also awarded a gold medal for its display of electric fans and motors at the Panama-Pacific International Exposition, San Francisco, Cal.

Westinghouse, Church, Kerr & Company, 37 Wall Street, New York City, have issued bulletin No. 18 entitled "Routing". This is a folder issued as a typical example of the great care with which the question of routing materials through an industrial plant is treated by this well known firm of engineers and constructors. An illustration on the cover of the folder shows graphically the simple method of routing raw materials and products in various stages of completion that is used to facilitate operations in a large industrial plant. Such studies made before the plant is designed and constructed aid very materially in maintaining high efficiency and low production costs in large manufacturing plants.

Monarch Refillable Fuse Company, 1048 Jefferson Street, Buffalo, N. Y., has recently purchased a large plot of ground at the corner of Leslie Avenue and East Ferry, Buffalo. Upon this will be erected the new factory of the company, which will include a new experimental laboratory for the development and perfection of many electrical devices that the company will manufacture. This new factory will give the company not only more ample space to take care of its increasing refillable-fuse business, but also enough space to install new machinery and equipment to manufacture the new Monarch soldering iron, which it is placing on the market under recent patents issued to the vice-president of the company.

H. W. Johns-Manville Company, New York, N. Y., has recently moved its Chicago headquarters into a handsome new building on Michigan Boulevard and Eighteenth Street, in the heart of the automobile sales district. The main floor is divided up into various sales and showrooms for the many products handled by this company; one of these is a well equipped automobile service station. Conspicuous among the showrooms is the equipment of the lighting department, where exhibits of the company's Frink lighting system, Linolite lamps, Mitchell-Vance artistic metal fixtures and Gill-Parian glassware are displayed to the best advantage. The arrangement of the executive and general office on the second floor is well planned for efficiency and good service.

Hotpoint Electric Heating Company, Ontario, Cal., manufacturer of the well known Hotpoint electric household heating devices, has secured the grand prize for its exhibit of electrical heating appliances at the Panama-Pacific International Exposition at San Francisco. The company also secured the gold medal for its exhibit in the Home Economy Building at the Panama-California Exposition at San Diego. The award of these prizes calls attention to the phenomenal growth of this company, which only twelve years ago started as the Pacific Electric Heating Company on a very small scale at Ontario, Cal., the organization including only three persons at the time. After putting out the well known Hotpoint iron, improving it and adding from time to time the great variety of other heating devices which it now produces, the company has grown to the position where it now claims to be the largest exclusive electrical heating-appliance manufacturer in the world.

Record of Electrical Patents

Issued by the United States Patent Office, September 14, 1915.

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,153,195. Electric-Lamp Socket. C. B. Clark, East Orange, N. J. Combined socket, hickey and shade-holder. (See cut on next page.)

1,153,210. Apparatus for Operating Two Mechanisms in Synchronism. G. W. Ford, Gourock, Scotland. Arrangement of tripolar motor to synchronize the camera or picture projector and sound producer or recording machine.

1,153,257. Switch. L. Reinhard, assignor to Mechanical Appliance Co., Milwaukee, Wis. Rotating centrifugally operated motor switch closed at a predetermined speed to short-circuit motor winding.

1,153,284. Lamp and Support for Same. J. T. Beechlyn, assignor to General Electric Co., Schenectady, N. Y. Luminous arc lamp having arc and inclosing globe above operating mechanisms.

1,153,286. Tool for Stripping Insulation-Covering from Electric Wires. H. D. Cahill, assignor to F. W. Whitcher Co., Boston, Mass. Hand tool having arrangement of splitting and stripping blades facilitating removal of insulation.

1,153,290. X-Ray Target. W. D. Coolidge, assignor to General Electric Co. Comprises a body of molybdenum and a body of tungsten upon which cathode rays may impinge.

1,153,330. Cash-Register. W. H. Muzzy, assignor to National Cash Register Co., Dayton, O. Has motor driving coin-actuated levers after their actuated movement.

1,153,344. Coil-Forming Apparatus. M. Sandfield, assignor to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Details of apparatus for use indicated.

1,153,349. Attachment for Telephones. H. R. Smith, Washington, Pa. Pad and pencil device lighted by battery lamp and adapted to be attached to standard of desk telephone.

1,153,352. Telephony. A. W. Steinke, assignor to Monarch Telephone Mfg. Co., Fort Dodge, Iowa. Exchange arrangements for accommodating lines from both

magneto and common-battery substations.

1,153,372. Power-Transmission Means for Operating Dynamos. A. Churchward, Boston, Mass. Tension device for dynamo drive belt comprising a yieldingly held fan pulley.

1,153,384. Electric Welding Apparatus. J. A. Heany, New York, N. Y. Resistance type; has electrodes under predetermined fluid pressure; duration of welding current is automatically regulated.

1,153,394. Outlet Box. C. J. Klein, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Has outer margin corrugated for co-operation with plastered walls. (See cut.)

1,153,400. Automatic Sprinkler Alarm and Indicator System. F. W. Milliken, assignor of one-half to C. C. Brown, Auburn, Me. Alarm is sounded when water is fed into balanced receptacle from the main and also when the supply is shut off from the main.

1,153,420. Push and Pinch Contact-Plug for Flashlights. A. Brody, New York, N. Y. For use in cigar-shaped battery flashlight.

1,153,422. Potential-Regulator. H. W. Cheney, assignor to Allis-Chalmers Mfg. Co., Milwaukee, Wis. Drum-type controlling switch for manipulating transformer taps.

1,153,431. Instrument for Reproducing and Magnifying Sound Waves. C. H. Hulbert, Manila, Philippine Islands. Particular arrangement of coils and permanent magnets with relation to two diaphragms forming sides of thin cylindrical chamber.

1,153,438. Electrolytic Cell. E. E. Norquist, assignor of one-half to Oxygen Gas Co., Kansas City, Mo. For electrolysis of water; comprises special arrangement of cathode containing water, gas bell, flexible diaphragms, etc.

1,153,443. Reflector for Vapor Lamps. J. C. Pole, assignor to Cooper Hewitt Electric Co., Hoboken, N. J. Two similar truncated segments are arranged to reflect light past source.

1,153,445. Lamp. J. T. Roffy, assignor to Nernst Lamp Co., Pittsburgh, Pa. Projecting lamp comprises lens, tube and lamp socket with globe between socket and lens and surrounding lamp.

1,153,446. Lamp and Reflector. J. T. Roffy, assignor to Nernst Lamp Co. Arrangement of reflecting surfaces to avoid interference by lamp with reflected light.

1,153,468. Stippling Pen. J. H. Vaughn, Oakland, Cal. Comprises electromagnetic vibrator for vibrating the pen.

1,153,474. Armature. T. Abtmeyer, assignor to Westinghouse Electric & Mfg. Co. Core for dynamo armature.

1,153,497. Combination Portable Rope Hoist. S. E. Kalback, assignor to Reading Crane & Hoist Works, Reading, Pa. Either hand or motor-driven.

1,153,505. Means for Divided Control of an Electric Signal Device. M. Levison, assignor to W. P. Crockett, Chicago, Ill., and L. Hammond, Evanston, Ill. Automobile tail-light circuit closed by dash switch and opened by tail switch.

1,153,507. Combined Electrolier and Telephone-Cover. J. McIntosh, New York, N. Y. Standard of electrolier forms cabinet for receiving desk telephone.

1,153,515. Trolley-Actuated Switch. E. H. Owsley, San Jose, Cal. Arrangement for operating multiple switch by passing trolley wheel.

1,153,530. Indicator. C. F. Zinn, St. Paul, Minn. Automobile direction signal having arm and illuminating signals electromagnetically operated in synchronism.

1,153,542. Automatic Telephone System. A. H. Dyson, assignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Special arrangements for non-interference with relation to line selectors and master switches.

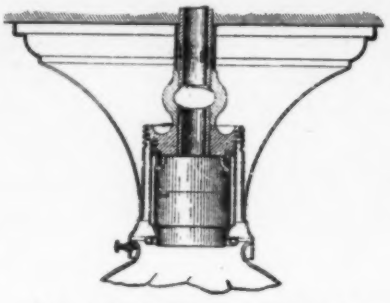
1,153,572. Telephonic Apparatus. W. Rohde, Lincoln, Neb. Battery lamp on telephone controlled by receiver hook.

1,153,573. Supervisory System for Sprinkler Valves. W. A. Rogers and M. R. Parker, assignors to W. G. Cornell Co., New York, N. Y. Electrical means for indicating whether a valve is open or closed and sounding alarm when the valve is in an intermediate position.

1,153,575. Electric-Tool Handle. F. A. Rowley, Sparta, Mich. Details.

1,153,580 and 1,153,581. Electrical Connector. C. L. Sheppy, assignor to Pierce-Arrow Motor Car Co., Buffalo, N. Y. First patent; plug connector for securing to support through which wire passes. Second patent; for making connections through support; insulating structure extends through support and receives plugs at its ends connected by spring structure.

1,153,591. Lamp Socket. W. F. Anklam,



No. 1,153,195.—Composite Socket.

assignor to C. M. Hall Lamp Co., Detroit, Mich. Comprises two telescoping portions held in engagement by spring and released by rotation against spring.

1,153,593. Telephone Receiver. N. Baldwin, Mill Creek, Utah. Particular arrangement of electro and permanent magnets, the armature being mechanically connected with the diaphragm.

1,153,605. Furnace-Charging Apparatus. W. F. Clark, Coraopolis, Pa. Pieces to be charged into furnace are magnetically drawn into contact with feed rollers.

1,153,617. Lightning Rod. J. F. Goetz, Hartford, Wis. A hollow conductor is formed by twisting a flat strip and winding a number of wires about it.

1,153,653. Undertow-Warner Indicator Register. M. M. Voorhees, Oak Park, Ill. Submerged actuating element operated by undertow controls circuit of gong on shore.

1,153,655. Telephone Cable. K. W. Wagner, Berlin-Lankwitz, Germany. For self-inductive load; has insulating cover of gutta-percha-like material having small proportion of resin.

1,153,656. Electric Switch for Elevators. F. N. Wake, assignor to Specialty Development Co., New York, N. Y. Special structure for operation by door.

1,153,657. Fuse-Carrying Connecting Device for Electrical Conductors. F. N. Wake, assignor to Specialty Development Co. Has removable end contact caps for ferrule-type cartridge fuse.

1,153,658. Ice Chute. J. C. Warren, Emporia, Va. Has electric indicator controlled by cakes passing along chute.

1,153,667. Power Generating and Transmitting System. V. G. Apple, assignor to Apple Electric Co., Dayton, O. Special structure of dynamo for mounting on engine of automobile.

1,153,672. Rail-Clamp for Traveling Bridges. R. E. Brown and E. C. Gaines, assignors to Heyl & Patterson, Pittsburgh, Pa. Motor-operated weight actuates clamping device.

1,153,703. Electric Heater. S. I. Phelps, Buchanan, Mich. Integral disk of insulating material has resistor wound on it in particular way.

1,153,717. Means for Generating and Radiating Electromagnetic Waves. G. Seibt, assignor to Radio Telephone Co., New York, N. Y. Arrangement for producing weekly damped waves comprising an oscillating circuit haing a condenser, inductance and spark gap in series with an independent auxiliary quenching gap.

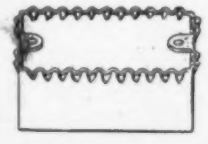
1,153,737. Bargain Indicator. L. J. J. Vanderhoorn, and S. Wouda, Utrecht, Netherlands. Electric sale apparatus comprising price indicator and signal controlled by customer with arrangement for locking out any attempted control subsequent to the first.

1,153,739. Semaphore-Operating Mechanism. C. W. Ward, Lakewood, O. Intermittently operated; electromagnetic.

1,153,755. Circuit-Closer for Fire-Alarms. F. W. Bost, China Grove, N. C. Particular contact structure.

1,153,765. Circuit-Breaker. J. Cuculic, Fiume, Austria-Hungary. Special structure of overload device with delayed opening.

1,153,767. Igniter Mechanism for Internal Combustion Engines. H. R. VanDeventer, Sumter, S. C. Unitary structure



No. 1,153,394.—Switch Box.

of magneto and make-and-break igniter.

1,153,786. Reduction of Metallic Oxides and the Like. F. W. Highfield, Caversham, England. In a furnace for the recovering of zinc from its oxide carbon is electrically heated to produce an atmosphere of carbon monoxide.

1,153,794. Mercury-Vapor Rectifier and the Like. J. Jonas, assignor to Aktiengesellschaft Brown, Boveri & Cie, Baden, Switzerland. Special connections with transformer windings of a number of rectifying elements having anode and cathode circuits.

1,153,813. Conductor Support. W. M. Mordey, London, and J. W. Astley and D. B. Saunderson, Prescot, England. Support fits into undercut longitudinal slot in trolley conductor and is two-part so that it can be entered in mouth of slot.

1,153,821. High-Voltage Protection. W. Peterson, Darmstadt, Germany. Particular arrangement of resistance, inductance and condensance in relation to ground connection.

1,153,829. Take-Up for Flexible Electric Conductors. E. F. Rueckert, Providence, R. I. Special structure of reel for automatically taking slack out of conductors.

1,153,839. Electrical Therapeutic Apparatus. R. W. Chapman, Oldtown, Me. A rotatable carrier moves terminals through liquid resistance having submerged terminals, thereby progressively increasing and decreasing resistance.

Reissue 13,978. Automatic Safety Lock for Doors. J. W. Hulme, assignor to Consolidated Car Heating Co., Albany, N. Y. Original No. 990,877, dated May 2, 1911. For car doors; electromagnetic means provided for preventing other than the simultaneous operation of door-actuating device and the lock.

Patents Expired.

The following United States electrical patents expired on September 20, 1915:

610,887. Automatic Circuit-Breaking Switch. W. F. Bossert and W. D. Pomeroy, Utica, N. Y.

610,894. Electric-Railway Car Truck. G. J. Capewell, Hartford, Conn.

610,895. Controller for Electric Motors. F. E. Case, Schenectady, N. Y.

610,898. Electric Arc Lamp. M. Harris, New York, N. Y.

610,899. Electric Meter. C. D. Haskins, Newton, Mass.

610,903. Circuit-Breaker for Three-Wire Systems. E. H. Hewlett, Schenectady, N. Y.

610,904. Safety Device for Dynamo-Electric Machines. E. M. Hewlett.

610,907. Apparatus for Electroplating Articles in Bulk. G. Langbein, Leipsic, Germany.

610,908. Electric Brake. J. B. Linn, Schenectady, N. Y.

610,909. Rail Bond. J. E. Lloyd, New York, N. Y.

610,913. Boiler-Feed Regulator. C. B. Mitchell, Hays, Texas.

610,928. Electrostatic Measuring Instrument. E. Thompson, Swampscott, Mass.

610,982. Electric Locomotive. W. S. G. Baker, Baltimore, Md.

610,999. Electric Heater. J. F. McElroy, Albany, N. Y.

611,000. Electric Coupling. J. F. McElroy.

611,001. Electric Heating System. J. F. McElroy.

611,006. Combined Generator and Steam Engine. M. L. Whitfield, Memphis, Tenn.

611,012. Electric Battery. V. Jeanty, Paris, France.

611,056. Electric-Railway Construction. W. Chapman and P. W. Davies, Pittsburgh, Pa.

611,087. Contact Finger for Controllers or Electric Switches. T. von Zweigbergh, Cleveland, O.

611,088. Governing, Reversing and Braking Controller. T. von Zweigbergk.

611,089. Method of and Means for Controlling and Cutting out Electric Motors. T. von Zweigbergk.

611,090. Controller. T. von Zweigbergk.

611,100. Electroplating Apparatus. H. R. Boissier, New York, N. Y.

611,142. Electric Furnace. R. Pignotti, F. L. Scipione, Regnoli, M. Besso and M. Pantaleoni, Rome, Italy.

611,148. Apparatus for Electrically Coating Wire. W. S. Rawson, London, England.

611,151. System of Electrical Distribution. C. F. Scott, Pittsburgh, Pa.

611,162. Electric Arc Lamp. F. S. Worsley, London, England.

611,175. Galvanic Element. R. Krayn and C. Koenig, Berlin, Germany.

611,185. Rheostat. C. H. Richardson and L. McMakin, Jr., Philadelphia, Pa.

611,206. Circuit-Interrupting Device. D. M. Moore, Newark, N. J.

611,215. Electric Controller. S. Harris, Twinsburg, O.